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RAILROADS SERVE THE MEN AND MACHINES OF WAR (*See Article, Page 503*)

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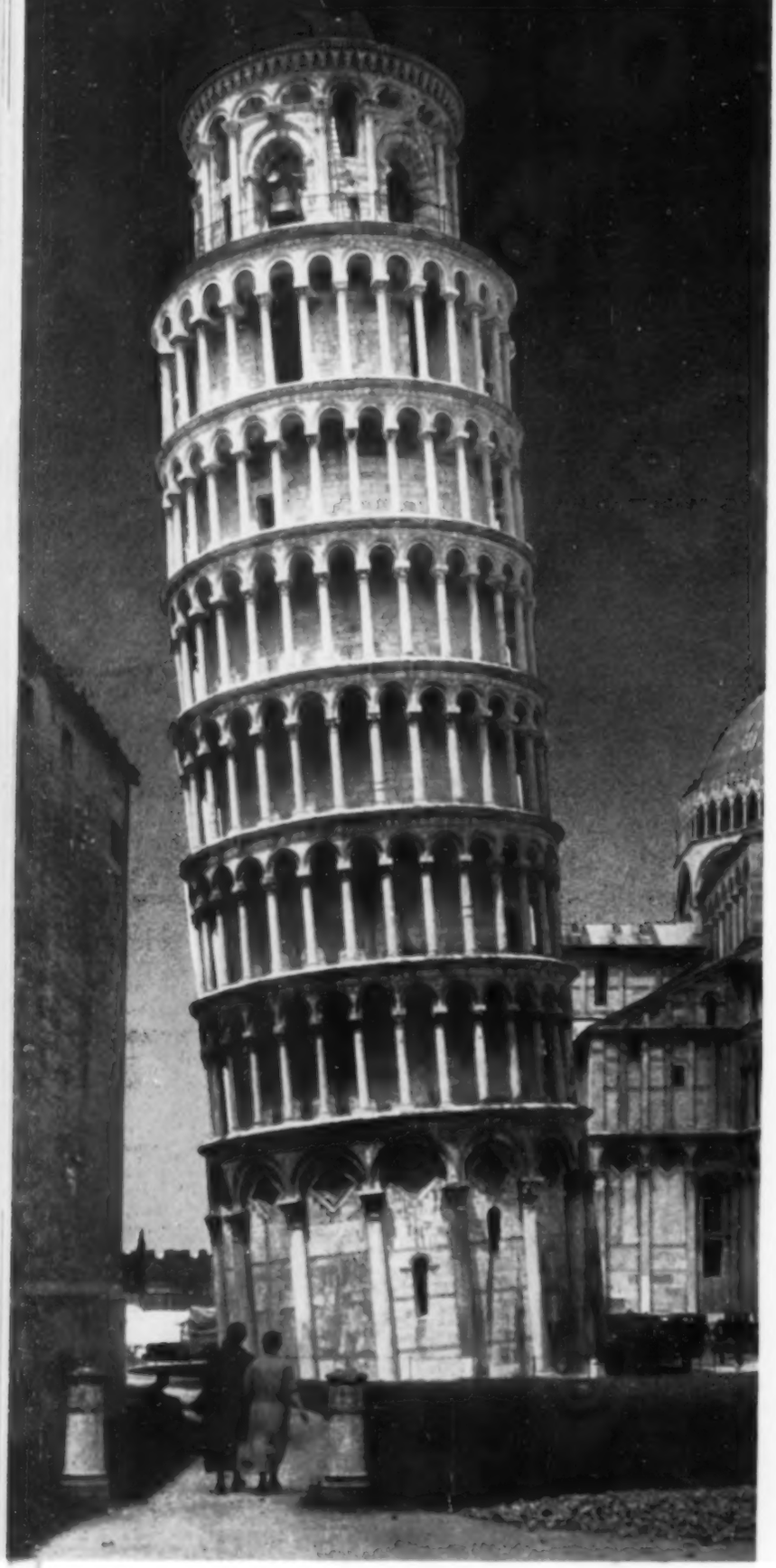
W THE OLD WORLD

REAK OF THE NEW!



THE Leaning Tower of Pisa – the wonder is that it still stands. An architectural triumph from the ground up, ignorance and blind speculation rooted it ten feet into the earth with a foundation circumference equal only to that of the building itself. Today – sinking and turning at its base – the Tower stands as an object lesson in 'How *not* to construct a foundation.'

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Either he continues thus and becomes an expert in

Engineering economics courses, the graduate feels

Something to Think About

A Series of Reflective Comments Sponsored by the Committee on Publications

A Graduate Check

By E. H. CAMERON, M. AM. SOC. C.E.
JACKSON AND MORELAND, BOSTON, MASS.

WHY should there be a silent partner among the three groups who are qualified to write on engineering education—the professors, the teacher-consulting engineers, and the graduate group? The professors speak with academic authority; the consultants practice what they teach and hence speak with added weight; but the graduates usually are not heard from at all.

This is unfortunate. Without trespassing unduly on the professor's sphere, the graduate can still give excellent advice provided he restricts it to the value of classroom teaching when applied to field problems. Thus the graduate can help the professor in his efforts to season the classroom atmosphere with an air of practicality without destroying the scientific spirit that should predominate there. A knowledge of how working engineers think and act as they build their structures and operate their machines—this is what the graduate can offer the professor.

An Opportunity Neglected.—Why should the "old grad" neglect his opportunity to specify what should go into the instruction of his assistants? Would he buy a carload of cement without rigid specifications? We may also inquire why the professor does not ask the graduate's advice more frequently. It is the pragmatic test that counts; the vote of the mechanic who uses the tool must be recorded before the toolmaker's design can be pronounced successful.

Since, however, graduates are so reticent, let us pick one at random, label him "average specimen," and write his biography from the time he receives his degree until his twenty-fifth reunion, checking up on his opinion as to the fitness of his college training at various stages of his career. Then we may ask him to boil these opinions down to a general conclusion.

We must insist that our man be an average engineering graduate—neither one who has become the head of a large corporation nor a fellow who has tired of engineering and gone into Fuller brushes or the raising of chickens. And of course he cannot be a college professor because that would hopelessly confuse the issue. He must be an amateur in educational processes, that is, a man who learned engineering and worked at it, starting in a position of minor responsibility.

The First Job.—When we first look in on him he is struggling with his first job. His boss is a peculiar person; he is hard to understand and appears a little obtuse at times. He is unimpressed with the self-acknowledged capacity of his assistant to design a suspension bridge or a Norris Dam but can show great acumen in detecting minor errors in the young man's bill of material for the concrete form lumber.

Naturally this boy is disillusioned. He is apt to wish that he had been taught more practical things so that he would be less frequently embarrassed by the arithmetical brilliance of the high school boy who sits at the next estimator's table. The worth of such cultural subjects as literature and languages seems slight. He feels that he could better have spent the time in courses which taught quick ways to count rivet heads or how to make lumber schedules.

But graduate engineers grow up. The young man becomes a designing draftsman or a junior engineer. He gets an occasional thrill now as he finds his opinion beginning to carry weight when problems in higher structural design or heat transfer or complex electrical circuits are discussed. Why were there not longer courses in elastic frame analysis, or advanced thermodynamics, or high voltage phenomena? That's the criticism at this stage.

Or perhaps he is put in the specification department. Then that bothersome course in English composition looks more useful; and the course in business law, which in college was merely a pleasant diversion, gets a little review as he tries to keep his engineering contracts straight.

Youth Is Introspective.—Up to now one state of mind has predominated—the introspective. While he gives a little attention to keeping the boss happy, his mind is concerned mostly with his own mental processes in an effort to improve them. He studies his errors so as not to repeat them. In other words, at this stage in his career, he sees nothing in the various humanistic courses that he took in college.

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Either he continues thus and becomes an expert in some narrow field or, showing an ability to handle others, he mounts to executive positions of increasing importance. Now the qualities cultivated in the humanistic courses assume weight. Not book-learning in psychology or the theories of social science are what count, but what can be translated into the language of common sense—ways to size up people and read their minds—as is frequently necessary.

As he becomes a better executive he develops greater and greater understanding of men; he learns how to make them do things his way and like it. Now he is a real engineer; he can handle any job that comes his way, and he continues happily to do so for a decade or two until he reaches the next stage.

The Stage of Disillusionment.—For some engineers—a few only perhaps—this next stage is one of disillusionment. They wonder why they worked so hard on this or that assignment in order that the stockholders in some industrial enterprise might make more money. Was it worth while to cooperate with groups of politicians incapable of appreciating the difference between a dollar saved for the city and a dollar wasted by putting some park-bench engineer on the payroll? Such graduates sense a glaring defect in the curriculum at this stage. It should have placed the main emphasis on philosophy—or been a skillful blend of the teachings of Mahatma Ghandi, Coué, Buchman, and Dale Carnegie.

We have observed that the scope of the curriculum was successively wrong, right, and wrong according to the stage of the graduate's development. The engineer realizes, now, the magnitude of the task which faced the college executives as they set up the prescribed course of studies.

Now that our specimen graduate has reached an age where his opinion should have a definite experience value, let us ask him to sum things up for the professor who is training embryonic engineers.

A Judgment with Perspective.—Naturally, the graduate says, some of his college courses are but vague memories; others have been as indispensable as a carpenter's hammer. The graduate wishes that he had been given a heavier hammer—that is, more knowledge of mathematics and the other basic sciences. He feels that today's graduates get this; apparently more college hours are being devoted to the basic sciences. The added time spent on these must have been stolen from the so-called practical subjects. Spendid! The consulting and field offices are full of men competent to provide such instruction.

For his next conclusion the graduate suggests that the schools emphasize the "half-finished" nature of college training, telling the boy that when he has learned how natural forces work he has mastered only half the subject. Somewhere he must learn the other and equally important half—how natural forces are put to work. Some college kindergarten instruction is needed in how they are controlled and directed to effect the completion of an engineering project; who does what; and what the young engineer's share in the program will be. It is the older engineer's duty to teach the details of the management of engineering enterprises. College can help him by teaching the student the broad principles of handling men. Is this too large an order?

Engineering economics courses, the graduate feels, should impress on the student the necessity of searching for the hidden elements that are frequently of greater importance than conclusions derived from investment tables and efficiency curves. Perhaps there should be a few hard-boiled "owners" on the college staff to expound the "got-to-make-a-dollar" instinct; for the ultimate decision to spend the money—or not to spend it—seems frequently to be based on this instinct of the owner or his consulting engineer. Thus the boy must be warned that economic studies may be dangerous unless plentifully saturated with common sense.

The Difficult Art of Expression.—Then there is the inevitable problem of explaining things to mechanics and others. The student must be brutally purged of a love of high-sounding phrases. The appalling vocabulary of engineering texts must somehow be simplified. Let the instructor tell the student to make his explanations as simple as possible; any other course has the taint of intellectual snobbery.

The next conclusion of the graduate reiterates the ancient complaint that the engineer lacks facility in speech and writing. Less Shakespeare and more journalism in the English courses might be suggested. To help the student, as well as the superior to whom he will one day have to report, teach the value of a proper headline. Let him study the "who, what, when, where, and why" that the reporter is taught to include in his first paragraph—the lead that tells what the rest is all about.

Drama is essential knowledge for an engineering student, the graduate believes. In an engineer's business relations he is constantly using methods which depend for their success upon his skill in the use of dramatic elements. Conflict, suspense, atmosphere, crisis, and climax—all are there when the salesman of engineering equipment lands a big order, or when the chief engineer of the department of public health outlines proposed measures to recalcitrant politicians. Need it detract from the esthetic atmosphere of the class in Shakespeare to mention the practical value of drama?

The "Old Grad" Sums Up.—And now, in conclusion may the old grad be allowed to speak directly to the student?

"Young man, you are now receiving competent classroom instruction which teaches why natural forces act as they do. Study hardest the basic sciences—mathematics and the rest. Shortly you will step out of the classroom and learn how men set these natural forces to work; how structures and machines grow from the promoter's hunch, via the consulting engineer's studies and blueprints, into the finished product. Proudly you will progress through the organization which achieves this result.

"It is a fascinating equation that expresses the relationship between the three elements of engineering accomplishment—scientific knowledge, men, and dollars. Acquire a deep insight into the complexities of the first element, scientific knowledge. Later you can enlarge your understanding of the less predictable second element, men, as you direct their efforts in various engineering enterprises.

"The third element? Ask the professor of engineering economics—the vagaries of the dollar element are beyond the scope of these counsels."

concrete end sections of twin-tube subway, each about

earth pressure acted only after the section was sunk in the trench in the Chicago River.

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The Chicago River Subway Crossing

Procedure Followed in Placing Twin-Tube Section in Trench on the River Bottom at State Street

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SIMULTANEOUS construction of the subaqueous subway crossing and the State Street Bridge required careful coordination. A profile of the approaches to the crossing indicated a clearance of only a few feet between the top of the tubes and the bottom of the river. To meet this condition and at the same time avoid restriction of the navigable channel, or delay to the State Street bridge piers, the plan was to lower a prefabricated section into a dredged trench. Careful determination of existing obstacles to excavation and construction made a fast schedule possible.

THE State Street route of Chicago's initial system of subways crosses the Chicago River only a short distance north of the Loop area and on a line where bridges have spanned the river since 1864. When the plans for the present system of subways were revived in 1937, one of the earliest problems was to determine the location, type, and layout of this river crossing, and its construction in connection with that of the new State Street Bridge. A new bridge had been contemplated for this location since 1930 and studies made at that time for a subway assumed that some coordination between bridge and subway construction would be required.

PREFABRICATED SECTIONS IN DRY DOCK
Bottom Slab Poured and Reinforcing Placed for Side Walls

Plans for the State Street subway station disclosed the desirability of extending the platform as far north as possible in the Loop area. (See "Coordinating Design and Construction on Chicago Subway," by Peter F. Girard, CIVIL ENGINEERING, March 1942). To avoid excessive grades in the subway profile, the river crossing section had to be maintained as high as possible. Various methods of constructing the section under the river were proposed, including (1) use of a clay blanket over the river bottom to provide sufficient cover for tunneling methods, (2) cofferdams half way across the river so that the crossing could be constructed in two units, while maintaining a channel for river navigation, and (3) construction of a prefabricated section, either of steel, concrete, or combinations of these, that could be sunk into a trench excavated by dredging in the river bottom.

The first two methods were considered objectionable because the Chicago River is a navigable stream with a considerable amount of river traffic. Consequently the third method was finally adopted. Inasmuch as the construction of the new State Street Bridge was scheduled to proceed at about the same time as the subway, it was agreed by the Department of Subways and the Department of Bridges that common cofferdams, one on each side of the river, could be utilized for the construction of short sections of the subway and also for the bridge pits and foundations.

A 200-ft length of prefabricated twin-tube steel shell was adopted, lined inside and out with concrete. The

SITE OF THE STATE STREET CROSSING
Twin-Tube Sections in Lie-By Bay

advanced to avoid erection difficulties caused by expansion from the welding operations. The steel shell of each

INTERIOR OF ONE TUBE BEFORE CONCRETING
Stiffening Ribs and Channel Tracks for Platform Traveler Have Been Placed

concrete end sections of twin-tube subway, each about 65 ft long, were to be built in the cofferdam. Bell-end construction was provided at their outer ends for connection with the land sections of subway, which were to be constructed later in tunnel, one from the south and the other from the north. Included in the cofferdam work done by the Department of Subways was the construction of four sub-piers in the south cofferdam and two sub-piers in the north cofferdam for the new State Street Bridge. (See "Design and Construction of North State Street Bridge, Chicago," by Donald N. Becker, CIVIL ENGINEERING, March 1942.)

The portion of the subway tubes constructed in tunnel was designed as a twin-tube horseshoe section having a width of 15 ft and a height of 16 ft $9^1/_2$ in., with a center wall thickness of 4 ft and a center-to-center track distance of 19 ft. In order to avoid track offsets in the approaches, the same sections and dimensions were maintained for the concrete lining of the river crossing section. The steel shell is approximately the same shape as the lining with the exception of the invert plate, which is curved, the better to withstand the water pressure.

To use the steel of the shell most efficiently, T-irons were welded to the inside. These were selected because they provided the greatest stiffening value for their weight and also because they would be well anchored in the concrete. So that the concrete and steel might act as a structural unit, holes were provided in the stem of the T's through which longitudinal reinforcing bars were threaded. Steel diaphragms were welded to the outside of the shells at 12-ft intervals. They had three functions: (1) to stiffen the shells, (2) to connect the two tubes as one structure, and (3) to create a series of pockets on the outside of and between the shells for placing the exterior concrete. The diaphragms at 12-ft centers, and the T-irons at the third points between the diaphragms, provided stiffeners at 4-ft intervals.

THREE SEPARATE STRESS CONDITIONS CONSIDERED IN THE DESIGN

The steel shell and its reinforced concrete lining were designed by the theory of elasticity. The exterior concrete was not depended upon to resist loads. Several loading conditions were considered. Pressure due to a height of water sufficient to float the section was considered to act on the steel shell without any concrete (except that in the invert). This condition existed when the tubes were floated in dry dock. The effective water depth on the side wall of the shell was then about 7 ft. Water pressure was considered to act on the partially concreted section, a condition that occurred when the interior concrete lining was being placed, while the section was floating in the Calumet River. Full water and earth pressure acted only after the section was sunk in the trench in the Chicago River.

During the floating and towing operations, both longitudinal and transverse rigidity were required. It was also desirable to have the exterior concrete at the bottom of the section placed before the tubes were floated in the dry dock. To realize both these aims, all the concrete in the invert, both inside and outside the steel shell, was placed before the section was floated. Some concrete was placed up the sides of the shells to make a U-shaped section that would give the required longitudinal stiffness to the 200-ft length. The flat bottom slab also provided the broad, even base required to set the section accurately.

Alternate methods of supporting the section on the bottom of the trench were considered, including sand, concrete, and structural steel supports. Two concrete landing pads were used, located 40 ft from each end of the 200-ft section, and each capable of supporting a load of 200 tons. Other details that had to be considered in the design were the conditions of buoyancy at different stages in the construction, temporary bulkheads for closing ends of tubes for floating, hatchways and exit shafts that could be used in case of emergency, and pairs of special diaphragms at each end of the sections for making connections and closures with the cofferdams.

Top corners of the typical diaphragms were beveled so that there would be less chance of their being hooked during any future dredging operations. This was desirable as the top of the tubes would be only a few feet below the dredged bed of the river. The lower corners were also beveled, to decrease the necessary width of the trench.

The 200-ft by 39-ft 6-in. prefabricated twin-tube unit was constructed in a dry dock of the American Ship Building Company at 101st Street and the Calumet River in South Chicago. A level timber deck was first laid on the sills of the dry dock to serve as a bottom concrete form and as a working deck for the erection and fabrication of the steel. The timbers were securely fastened down and four layers of building paper were laid over the top to prevent the decking timbers from adhering to the bottom of the concrete in launching.

The steel shells were erected by two locomotive cranes operating from the sides of the dock. Welding, other than tack welding, was deferred until the erection was well

FORMS FOR INVERT IN PLACE
Openings Have Been Made in Crown for Admission of Concrete

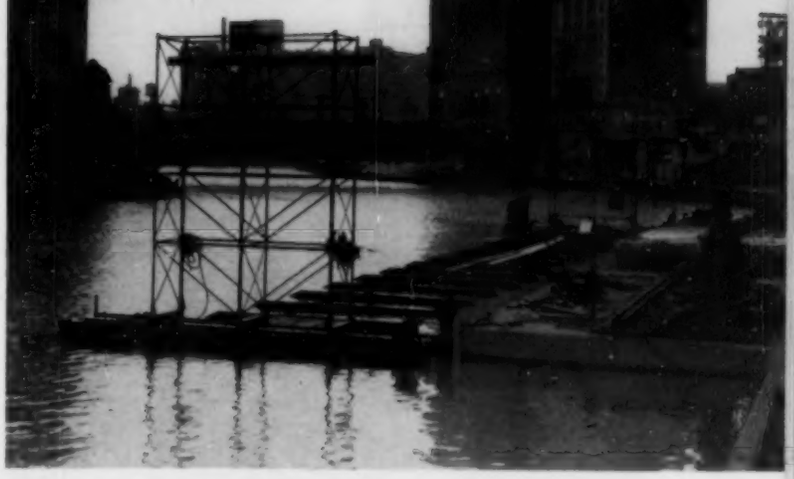
advanced to avoid erection difficulties caused by expansion from the welding operations. The steel shell of each tube was made up of rings 8 ft long with five individual plates to a ring. Backing-up strips, $^1/_8$ in. by $1^1/_2$ in. were tack welded to all seams. Both welding and erection were facilitated by the use of a platform traveler operated on channel tracks temporarily welded to the inverts. Each welder was required to qualify by the usual test-specimen method. Eight electric welding machines and a total of 5,300 lb of welding rod were required to fabricate the 252 tons of steel.

TUBES MADE WATER TIGHT

After welding was completed and the steel bulkheads were in place, all seams were tested for leaks with a water jet of 100-lb pressure. As a final check, each tube was subjected to $^1/_2$-lb internal air pressure, and all seams were swabbed with a soap solution. All areas around leaks were rewelded, so that at this stage the tubes were absolutely water tight. Careful studies were made to determine what concrete should be placed before launching and what should be placed after. The structural design was based on the assumption that all the interior concrete lining would be placed before the unit was sunk, but permitted the placing of part of this lining while the tubes were afloat. The contractor elected to place about 1,100 cu yd while the unit was in dry dock. This included the bottom slab, invert lining, parts of the exterior and center walls, and 12-ft sections of lining at the ends. These latter sections were placed to take the thrust of the wide-flange beams that were a part of the steel bulkheads. Five-foot sections of the center wall were placed at each end of the unit for the full height of the tube to prevent water from entering the space between the tubes. The exterior walls were completed to a height of 7 ft above the bottom forms.

Concrete was wheeled from the mixer in buggies on timber runways built over the tops of the tubes. To place the concrete lining, temporary openings were cut in the crown of the steel shells at intervals of 16 ft. Timber forms for the exterior walls were bolted to the stiffener angles of the diaphragms. With all the interior and the exterior reinforcing steel and formwork erected, and with protective bulkheads of 12 by 12-in. timbers on each end, and towing rings attached, the unit was ready to be floated from the dry dock. With a draft of 11.73 ft, the unit was towed across the river to a slip having a 20-ft depth of water.

River Crossing Section, with Timber Bulkheads Attached, Being Towed Through Lock at Mouth of Chicago River



Submerging at State Street Crossing
Note Alinement Towers at Both Ends

In this slip the remainder of the concrete lining was poured and the temporary access openings were sealed. Additional concrete was placed in the center wall to secure the desired draft. The unit, with a total of 1,840 cu yd of concrete in place, and with a draft of 18.11 ft, was then ready for its trip down the Calumet River, into Lake Michigan, and finally down the Chicago River to State Street. Two tugs were used, one towing and one shoving on the timber bulkhead at the stern. The 18-mile trip required about 8 hours.

While work on the prefabricated unit was taking place, dredging operations were being carried on in the Chicago River along the line of the subway. The trench was dredged by a whirley derrick scow operating a 3-cu yd clamshell bucket. The material encountered was medium blue clay in which 1:1 side slopes were possible. Old wood piles of the bridge piers were removed by the clamshell bucket or with an A-frame mounted on the end of a derrick scow. The bottom of the trench was 52 ft below the river level and had a width of about 50 ft. The normal depth of the river was only about 20 ft. As it was planned to submerge the prefabricated unit and swing it into position suspended from scows floating over the top of it, it was necessary to provide a basin deep enough for this operation. This additional area of the river was dredged to a depth of 28 ft. A total of approximately 20,000 cu yd of material was removed.

The concrete landing pads were cast in place in two stages. Wood forms were built on shore for the 15 by 40-ft initial pads. Reinforcing steel was assembled and the entire unit lowered into position. The concrete surface was struck off about a foot below the final elevation of the bottom of the tube section. Steel forms for the 6 by 39-ft final pad were built on shore, and four screw jacks were attached to the sides for leveling. A structural steel tower, 20 by 6 ft, and 57 ft high, was erected on top of these forms. This assembly was lowered into place so that the jacks rested on the initial pad. By observation of previously established points on the upper portion of the tower and adjustment of the jacks by a diver, the tops of the forms were brought accurately to the proper elevation. After the concrete had set, the tower was removed, cut in two, and re-used for alining the tubes.

Where the cofferdams joined the ends of the prefabricated unit, steel sheet-pile cutoff walls prevented the river water from seeping under the ends of the tubes into the cofferdams. These walls were located $6^1/_2$ ft from

SCOWS MANEUVERING SECTION INTO ALINEMENT
Deck Engines Handle Entire Operation

the ends of the prefabricated unit and later became an integral part of the cofferdam. The tops of these 10-ft piles were left projecting about 2 ft above the excavation and were later encased in the concrete seal that was placed between the two special diaphragms.

ALINEMENT ACCURATELY DETERMINED

A sand bed having a minimum depth of one foot was provided under the prefabricated unit. The sand was first distributed somewhat higher than the finished grade along the center line of the trench. This was then screeded with a 40-ft steel beam suspended from the derrick scow to form a perfectly smooth surface. Because this portion of the subway was on a 0.37% grade, it was necessary that the screeding be done in a direction transverse to the trench, 40 ft at a time. The elevation of the screed was determined from tapes fastened to the ends of the beams. These were observed from a wye level on shore. A diver with a telephone set rode the beam and reported the progress of the leveling. In each section the screed was lowered a small amount for each pass until the theoretical bottom of the tubes was reached.

The steel towers were placed on the special steel diaphragms at each end of the subway tubes, and alinement targets were erected on the upper sections for observation during the sinking operation. Just before the tubes were sunk, a small quantity of wall concrete was placed to overcome most of their buoyancy. For final submergence, about 45 cu yd of pre-cast blocks were placed over the center wall. These were later incorporated in the tremie concrete fill over the tops of the tubes.

Two small scows, with deck engines and cables running down through wells, were used in sinking the tubes. With the tube unit submerged in the basin, these scows were floated over the top, and the cables were lowered in the wells and attached to the corners of the tube. The unit was then raised by the deck engines, which controlled not only its movement but also that of the scows. Approximately three hours were required to make the 90° swing and lower the unit into its final position. Subsequent measurements showed the unit to be within a small fraction of an inch from its planned position, both for alinement and grade.

After the unit was landed, the remaining 900 cu yd of concrete was poured into the side forms and over the top of the tubes by tremie pipe from a steel concreting tower with hopper mounted on one end of a scow. Sand backfill was then placed around the sides of the tubes, and a 4-ft blanket of clay was put over the top.

When the tubes had been sunk, the work of constructing the cofferdams was resumed. The south wall of the south cofferdam was placed before the old bridge pier was removed, to furnish support for the lower level of Wacker Drive. In the north cofferdam some of the sheet piling had been driven for the north wall. After the tubes were sunk, the remainder of the sheet piling for the cofferdams was driven, and the two upper sets of steel bracing were placed within the sheeting. The three lower sets of bracing were placed as the excavation proceeded within the cofferdams. The large number of wood piles remaining from the old bridge pier caused considerable delay.

A most interesting detail in the construction of the cofferdams was the method used in framing around the ends of the tubes projecting into the cofferdams. Piles of the cutoff wall were so spaced that each end pile could be interlocked with a long special sheet pile, forming the first long sheet of the cofferdam. Connected into these same interlocks was another series of short sheet piles that closed the space over the top of the tubes. Thus the sheeting for that portion of the cofferdam wall was completed. These piles were about 32 ft long and rested in a structural channel supported by 15-in. I-beams spanning the 7-ft space between the special diaphragms. The long piles just mentioned had an angle fabricated to each side on the line of the outer extremity of the diaphragms. These angles supported concrete forms which were placed in line with the ends of the diaphragms.

After all the piling adjacent to the tubes, and the steel forms across the ends of the diaphragms were in place, concrete was tremied in the space under, over, and on the sides of the tubes. Thus a continuous sheet-piling wall with a concrete seal at the special diaphragms of the tubes was provided.

ALL SECTIONS WATERPROOFED

When the cofferdams had been completed and the excavation carried down to grade, the twin-tube reinforced concrete section was constructed within each cofferdam. The only deviation from regular construction in this section within the cofferdam was the provision of a joint at the land end. Here the regular twin-tube section was stopped about 2 ft 6 in. back from the steel sheeting, with the dowels projecting through to the sheeting. In this space a special bell section was built outside the limits of the regular section. This bell provides for a suitable construction joint to connect with the tunnel work. The sections of twin tubes within the cofferdams were waterproofed on the sides and top with a five-ply membrane waterproofing.

Merritt-Chapman and Scott Corporation were the general contractors for this work, with E. W. Seemann, M. Am. Soc. C.E., as project manager, and E. L. Olsen as general superintendent. The entire subway project was designed by, and is being constructed under, the supervision of the City of Chicago, Department of Subways and Superhighways, of which Philip Harrington is Commissioner, Ralph H. Burke was formerly chief engineer, C. E. DeLeuw is acting chief subway engineer, and P. F. Girard, Jr., is assistant chief engineer (all Members Am. Soc. C.E.). The design and construction of this unit were under the supervision of the writers. The project was financed jointly by the City of Chicago and the Public Works Administration. Joshua D'Esposito and U. F. Turpin, Members Am. Soc. C.E., are, respectively, project engineer and assistant project engineer, PWA.

Sanitary Land Fills in New York City

By ROLF ELIASSEN, ASSOC. M. AM. SOC. C.E.
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IN these days economy is more than ever essential. It was such a consideration that led New York City to experiment with the old problem of disposing of dry wastes by means of a simple engineering procedure—continuous controlled dumping and covering with earth to prevent a nuisance. The principle behind this method and the success in carrying it out are explained here. The yearly savings on 11½ million cu yd are almost two million dollars over incineration. As a result of this experience, Dr. Eliassen is to introduce similar methods at Army camps.

TWENTY-seven million cubic yards of household refuse, consisting of paper, glass, garbage, wood, and other materials, are discarded yearly by the inhabitants of the City of New York. The disposal of this refuse has always been a problem of primary concern to municipal authorities, and new methods for accomplishing it are continually being sought. By the application of heavy earth-moving equipment to the handling of large volumes of material, the Department of Sanitation of the City of New York has developed a sound, economical, and efficient method of sanitary land fill to solve this difficult problem.

Methods of disposal that can be adopted by a large city are relatively few. Among those most commonly practiced are dumping, sanitary land fills, and incineration. Many factors may influence the selection of a method, although no excuse can readily be found for continuing the abominable practice of uncontrolled dumping, with its attendant hazards, such as fire, odors, and rodents.

VARIOUS METHODS AVAILABLE

Incineration involves the hauling of the material to centrally located incinerators and burning all the combustible content. It also requires that the waste contain a reasonable proportion of combustible material—a condition that is becoming increasingly more difficult to meet, with present-day reclamation of waste paper. There still remains the necessity for disposal of the incinerator ash. It may readily be seen that the initial cost of large incinerators, plus the cost of operation and final disposal, makes this an expensive method of handling great quantities of refuse. On the other hand, land fills require only a single handling of the material, with a consequent saving in cost. This is substantiated by the extensive cost records maintained by the Department of Sanitation. Table I presents the total yardage of material disposed of by each method, together with unit and total maintenance and operating costs, excluding interest or amortization charges, for the year 1941.

TABLE I. COSTS OF REFUSE DISPOSAL DURING 1941

METHOD	TOTAL, CU YD	COST, DOLLARS PER CU YD	TOTAL COST
Incineration	9,025,450	$0.231	$2,084,490
Disposal at Riker's Island	7,145,113	0.141	1,008,960
Sanitary land fills	11,227,484	0.069	776,590
Totals	27,398,047	....	$3,870,040

It will be noted that the cost of land-fill disposal is 70% less than that of incineration. On the 11,227,484 cu yd of land fill placed during 1941, this represents a saving of about $1,800,000 over the probable cost of incineration.

In addition to this obvious economy, reclamation of submarginal land, such as swamps, tidal flats, and marshes, is an important feature of land-fill practice. Mosquito-breeding areas and rat harborages along Jamaica Bay and the East River, as well as several inland ponds, have been filled to the extent of over 500 acres in the past four years. These include several parks made from reclaimed land. As a result, the surrounding property benefits by extensive development.

Close cooperation is maintained between the Park and Sanitation departments in the selection of sites, planning of fills, and carrying out of operations in order that reclaimed land may be converted to recreation uses with a minimum of effort after filling has been completed. Other areas have been utilized by the federal government, such as the 120 acres of marshland adjacent to Floyd Bennett Airport in Brooklyn, reclaimed by 6,000,000 cu yd of fill. This land is now being used to expand that important naval airport. At Fort Totten in Queens, about 50 acres have been added to the Army post by filling in salt marshland adjacent to Long Island Sound.

Vast areas of low-lying, mosquito-breeding marshlands in outlying non-residential districts offer suitable sites for land fills. In selecting a location there are two important factors to be considered. First, the site must be within economic hauling distance of the collection districts it is to serve; second, it must be so located that it will receive a sufficient volume of refuse to warrant a full com-

GENERAL VIEW OF OPERATIONS AT A LAND FILL
Truck Unloads Refuse and Bulldozers Push It Over Edge of Fill, While Dragline Excavates for Cover Material, Stockpiling It at Right

BULLDOZERS PUSH REFUSE OVER EDGE OF FILL

plement of personnel and equipment necessary for the proper conduct of such an operation.

Refuse disposal by sanitary land-fill methods is an engineering project from beginning to end. It consists essentially of burying all dry wastes, including garbage and incombustible matter, and of permitting decomposition and reduction to a stable inert fill.

When a site for a land fill has been definitely established, engineers are sent into the field to survey the area, peg out the boundaries, and set stakes showing the elevation to which the fill is to be carried. This is generally determined by future requirements of the Highway or Park departments, depending on the purpose for which the reclaimed land will be used. Grade stakes must be set at a height sufficient to allow for an approximate shrinkage of 30% during the two-year period of consolidation.

USE OF HEAVY EQUIPMENT

Heavy construction equipment must be assigned to each land-fill area. The two major items are draglines and bulldozers. Draglines weighing about 60 tons are best suited for this work. They are usually equipped with booms from 70 to 90 ft long and buckets of from $1^1/_4$ to $1^1/_2$-cu yd capacity. In order to maintain maneuverability under all conditions, it is desirable to have a low weight per square foot of bearing area. For this reason, the draglines are equipped with crawler traction or walking pontoons. The bulldozers should preferably weigh 20 tons and be equipped with crawler traction in order to be able to navigate over all parts of the fill.

Diesel engines for draglines and bulldozers have been found the most satisfactory for low fuel and maintenance costs. A road grader, crawler-traction dump wagons, dump trucks, chemical spraying equipment, and one or two 10-ton tractors for hauling these vehicles are also needed. Personnel to supervise and operate the various units includes a foreman, assistant foremen, dragline operators and oilers, tractor operators, truck drivers, and laborers.

After the area has been surveyed, and when operations are about to begin, a dragline starts excavating to obtain the sand underlying the area to be filled. If good sand is present, the excavation may be carried as deep as 20 ft. In most instances the material excavated can be used to cover the fill later. If suitable cover material is not available under the site, it must be hauled from the nearest point. This involves an additional cost, so is not resorted to unless the material under the fill is wholly undesirable as a cover medium. The excavated material is placed alongside the active fill area in stock piles. These should be within convenient reach of the dragline, and so located that they will not interfere with the movement of the refuse trucks.

LOGICAL ROUTINE DEVELOPED

The process of filling is carried out in strips of from 200 to 300 ft in width and in the sequence which is indicated for a typical area in Fig. 1. The first strip (*A*) is filled before beginning on the second (*B*), which in turn is filled, and so on until the entire fill has been completed. Each strip is subdivided into 100 to 150-ft sections, filled in the order which the numbers indicate. After Section 1 in strip *A* has been excavated and the underlying material piled alongside, filling proceeds. Meanwhile, the dragline excavates Section 2. In this manner, the dragline works one section ahead of the filling operations. Various other sequences of operation and different widths of strips have been tried. However, experience with the quantity of refuse, size and number of trucks, and the other equipment used in New York has indicated that this procedure is the most satisfactory. In cities where other conditions prevail, the economical width of strip will be different, depending on the quantity of refuse arriving at the fill. Although a narrow strip is desirable, the free movement of trucks, bulldozers, and draglines must be the governing factor in the operation of land fills.

Filling by strips has the advantage that all operations are confined within a relatively limited area, localizing activities and permitting a rigid control of operations. Since all the equipment operates in a smaller area, a greater degree of compaction results. Strip filling also permits an orderly arrangement of roadways for truck travel and a more convenient layout for excavating the cover material.

Filling begins with the unloading of refuse collection trucks at the site of the fill. The trucks back to within 15 or 20 ft of the face of the fill, are tilted to dump, and move forward while discharging their load. It would be dangerous for the trucks to approach any closer to the face of the fill as the outer material has not been compacted sufficiently. The remainder of the work is accomplished by 20-ton bulldozers. Two of these are generally assigned to each fill. Since they can maneuver readily in the softer and fresher material, they take the refuse from the points where the trucks have dumped it and push it safely over the edge of the fill. This operation is illustrated in one of the photographs.

The front edge of the fill is kept from 4 to 7 ft above the final grade, depending on the depth of fill, in order to provide for approximately 30% settlement. The amount of extra height is left to the judgment of the fill engineer, who decides on the basis of his experience with similar material. Levels are checked daily by the survey party. The economical depth of fill is usually limited to 15, or possibly 20 ft. If greater depths are desired over exten-

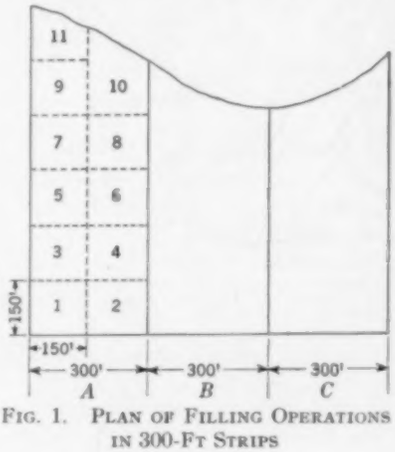

FIG. 1. PLAN OF FILLING OPERATIONS IN 300-FT STRIPS

sive areas, it will be advisable to complete the operation in two layers of approximately equal depth.

COVERING—AN ESSENTIAL FEATURE

As the fill advances, the dragline moves along the working area and covers the exposed top surface with about 6 in. of sand taken from the stock piles. The entire working area is covered after each day's operation. No adjustment of grade is attempted in the initial covering, as this is the responsibility of the bulldozer operators as they compact and trim the fill during the dumping period. Eventually the entire fill is covered with sand to a minimum depth of 2 ft. This covering cannot be applied until the collection trucks are through with the unloading of refuse, as sand spread to this depth would obviously interfere with the traction of the trucks. Where sand has to be carried beyond the practical casting limits of the dragline, it is loaded by the dragline into crawler traction wagons or dump trucks for distribution. Uneven parts of the surface are leveled off by putting on additional covering. Where this would require an excessive amount of sand, the depressions are first filled with ashes and then covered with sand to the proper depth.

AT A LAND FILL—DRAGLINE EXCAVATOR STANDS OUT AGAINST THE SKY

Covering the deposited refuse with sand is one of the most important items in the land-fill procedure. The compacted sand acts as a seal between the refuse and the atmosphere. Gases of decomposition, principally methane and carbon dioxide, neither of which is offensive, may diffuse through the sand to the air above. It should be porous enough to permit water to drain through to maintain a dry surface. Fires are prevented, as all the refuse is covered. The presence of sand enhances the general appearance of the completed fill and provides a base for future park development.

Perhaps the most significant purpose of the sand is to eliminate the possibility of rat harborage and the breeding of vermin and flies. Rats do not seem to adapt themselves to dry sandy areas where the organic matter is highly compacted and 2 ft below the surface. The land fill has become a cure for rat-infested areas in many instances. Public health officials with broad experience in rodent control have attested to the efficacy of this procedure.

Depending on the rate of advance of the fill, the surface slopes back in a regularly curved profile from the highest point at the face of the fill to the level finished surface. This latter part represents a virtually stable condition reached after approximately three months, as over 80% of the settlement takes place in this time. This does not mean that decomposition has been completed, as ultimate settlement is not reached for about two years. Although decomposition still continues at a slow rate after two years, settlement is negligible. Depending upon the thoroughness of compaction and the precision of grade adjustment at the face, the top of the finished fill does not generally show irregularities greater than about one foot.

Where the ultimate boundary of the fill has sloped sides, the bulldozers compact the material to a slope of approximately 3 to 1, as may be noted under the dragline in one of the photographs. A covering of sand is then placed over the slope. A bulldozer and crawler traction wagon can readily be operated to distribute the covering material. The treatment of these slopes by compacting and covering is a necessary procedure, for the same reasons that the top surface must be treated.

In the course of placing the fill, the wind will tend to sweep some of the refuse over the landscape. To a great extent this is prevented by the judicious placing of portable snow fences as close to the filling operations as practicable. These fences will generally catch any paper and other litter that may be carried by the wind as the trucks discharge their loads. As the fill progresses, the fence is also moved in order to provide the most complete freedom from this nuisance.

In times of national crisis, citizens are more careful to see that they do not discard refuse of any value. However, considerable material needed in defense industries is still being discarded and reaches the land fills. On most of these fills a contracting firm has a city-wide contract for reclamation of the refuse as it is deposited by the trucks. Pickers are active all during the day selecting rags, cardboard, and metal ware as each truck unloads. These men are required to avoid interference with the trucks and bulldozers and to work so that loose paper and other materials do not blow over the fill.

During the warm weather odors have been perceptible at land fills, particularly at the open working face. Control of these odors has been accomplished by spraying the refuse as placed with a solution containing chlorinated hydrocarbons. These chemicals have the beneficial properties of absorbing odors and keeping down flies and other objectionable insects. Experiments conducted in conjunction with the Land Fill Research Project at New York University showed that the beneficial bacterial decomposition was not retarded to any extent.

In the cooler months neither the odors nor the flies are as prevalent, and the addition of chemicals is not necessary. In order to prevent any undue odors in the city itself, each truck is washed as it leaves the fill. This is accomplished by running it on to a concrete platform at

DUMP TRUCK AND BULLDOZERS AT WORK PLACING SAND COVER

LAND-FILL OPERATIONS AS SEEN FROM THE COMPLETED FILL

the end of the fill and stopping for two or three minutes while the exterior and interior are flushed with the stream from a fire hose. This assures clean trucks and eliminates a possible source of odors.

Service roads are constructed over the land-fill surface to provide for the continuous operation of trucks from the street to the point of dumping. The base of these roads is usually broken concrete, stone, and asphalt salvaged from highway projects. To maintain a reasonably even surface, ashes and cinders are spread over the base and bladed with a road grader. These service roads enable the collection trucks to continue operations during all weather conditions.

Fire is an ever-present danger at land fills since the refuse includes much paper and other combustible matter. This is particularly true in winter, when hot ashes are frequently dumped with the other materials. To control this hazard, each land fill is equipped with pipe lines connected to the city water mains. Hoses are placed at convenient points to combat the fires which may break out from time to time. Vigilance on the part of the operating personnel has led to a satisfactory solution.

One of the main advantages of land fills under present war conditions is the fact that they do not require the use of materials needed for more vital purposes. At army cantonments or in cities, heavy construction equipment, such as draglines and bulldozers, is usually available after construction work has been completed. With conservation of critical materials assuming such importance, it is necessary for utility agencies to complete their tasks with equipment already available and requiring little or no valuable material for operation and maintenance. Land fills meet this requirement to a high degree.

Preservation of the public health is paramount in any sanitation project. When the fills were started, the fears of citizens residing close to them were aroused to such an extent that law suits were instituted against the city. The Supreme Court of the State of New York called upon a committee of public health experts headed by Dr. Thomas Parran, Jr., Surgeon General of the U.S. Public Health Service, to investigate the situation. They concluded as follows: "It is the opinion of the Board that there are no conditions presently obtaining at the five land fills which endanger the public health or safety. On the contrary, the Board is convinced that certain potential public health hazards obtaining previously at the sites of these fills have been diminished, for filling is one of the best methods of controlling rats and mosquitoes in marshes and swamps."

In the course of the land-fill survey conducted jointly by the Department of Sanitation and the Sanitary Engineering Research Laboratory of New York University, studies were made of the health record of land-fill workers. If any health dangers were prevalent, these men would be the first to succumb. Official records of the Medical Division of the Department of Sanitation reveal that for each 100,000 man-days of work on the land fills, employees lost 723 man-days on sick leave, or 0.723% of the time. During the same period, the main office employees of the Department were on sick leave for 2,237 man-days per 100,000 man-days of work, or 2.237% of the time. Industrial hygiene studies of a considerable number of industrial plants of all types by the Mellon Institute showed that the average time lost on sick leave was 1.182%. By comparison, the land-fill employees lose 39% less time than the average industrial employee, and 67% less than office workers in the same department.

LARGE VOLUME OF REFUSE HANDLED

The magnitude of the engineering problem confronting the Department of Sanitation can best be realized by considering the volume of refuse handled in comparison with that on other earth-moving projects of record-breaking scope. In the thirteen land fills in operation during 1941, a total of 11,481,992 cu yd were placed. In one fill alone, that at Fairfield and Pennsylvania avenues on the shores of Jamaica Bay in Brooklyn, 2,358,890 cu yd were placed in 1941. A heavy day, usually a Monday, may witness the arrival of 1,300 truck loads with 21,000 cu yd of refuse for this fill. The total for all land fills on a similar day will be about 50,000 cu yd. Since the inception of modern land-fill methods in New York in 1937, over 50,000,000 cu yd of material has been placed, about half the yardage of the world's largest dam, that at Fort Peck, Montana. Measured by any standard, this is a great volume of material, and the placing of it may be regarded as a gigantic engineering venture.

The Department of Sanitation is directed by Commissioner William F. Carey, with Deputy Commissioner Albert J. Lizee in charge of land fills. Charles J. Labdon is Assistant City Superintendent detailed to operate the land fills. The research and development program on land fills was carried out by the Department and the Work Projects Administration under the supervision of the staff of New York University's Sanitary Engineering Research Laboratory, of which Dr. Eliassen is director.

MODEL STUDY OF SANITARY LAND FILL

The Civil Engineer and the Wagner Act

Relationship of Professional Men to Collective Bargaining Must Be Clarified

By H. A. MILLIS

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THE active interest of every civil engineer has been drawn to the administration of the National Labor Relations Act for, whether employer or employee, the engineer has certain obligations and certain rights under the Act. The cooperation existing generally among engineers greatly simplifies the work of the National Labor Relations Board. This article by Dr. Millis continues the series originating with General Fleming's discussion of the Wage and Hour Law, in the June 1941 issue of "Civil Engineering," and followed by Mr. Walling's in the June 1942 number.

THE procedures of collective bargaining are more and more being knitted into the industrial habits of this country. Employers and their employees are learning how to arrive at written working agreements on wages, hours, and shop conditions through negotiation between their representatives. The extent of trade union organization is by far the greatest this country has ever seen. More than eleven million men and women are now members of trade unions. In manufacturing, transportation, shipbuilding, and most other industries vital to the war effort a majority of the workers are living under contracts arrived at through collective bargaining and renewable from year to year.

This marks a significant change in our industrial habits, and it is a change explained in large measure by the National Labor Relations Act, which guarantees the rights of workers to organize and bargain collectively. This Act is only seven years old. During the first three or four years under this law there were many employers—possibly a majority of them—who resisted the Labor Act out of their liking for the old management–individual employee method of dealing with workers. But by 1940 resistance to collective bargaining had relaxed. The right of workers to self-organization had been upheld by the courts. More important from the practical viewpoint, employers came to see that there may be distinct advantages in submitting the intricate details of the modern employment relationship to signed agreements. The question no longer was whether workers would be allowed to have union representatives, but rather it had become a question of which representatives they would choose in any particular plant.

CHOICE OF OUTSIDE UNIONS

Factually it is easy to demonstrate that American workmen, once allowed an opportunity to ballot in secret elections, usually had an underlying desire to place their wage, hour, and working-condition demands in the hands of trade union representatives. This could be illustrated by hundreds of cases. Typical are some of the first elections held after the Supreme Court upheld the National Labor Relations Act on April 12, 1937. A number of large companies had for some time previous to that date protested that their workers were completely satisfied with employee representation plans which barred outside unions. But when the Act was upheld and the National Labor Relations Board permitted to hold elections by secret ballot, in each instance unions were chosen by overwhelming majorities. This is also illustrated by the over-all data. In the five years since the Act was validated, more than two and a half million workers have voted in Board elections, and four out of five of those voting have chosen to be represented by a trade union.

This trend continues. During the past June the Board conducted 325 secret ballot elections and payroll checks in which 133,665 employees cast valid votes for collective bargaining representatives. Trade unions were chosen by 88% of the worker voters.

The greatest number of votes during the June elections were cast in the steel industry, principally in United States Steel. There were also large ballotings in ordnance plants, textile mills, lumber operations, chemical plants, and non-ferrous metal mines. Obviously these are industries which have supreme importance in war production, and the phenomenon of a swing towards trade unions in them is one which must not be overlooked in any appraisal of our industrial good health.

Why should civil engineers be interested in the National Labor Relations Act? For one reason, because many of them find place in top management. Most of those who do not occupy such positions are professionally employed in industries within the scope of the Act. Therefore it is well to explain here, in the simplest terms, exactly what the National Labor Relations Act describes as the obligations of employers and how it is applied in practice.

The Act is in reality a very simple law. When Congress debated it in 1935 the conclusion was reached that something should be done about the vast number of strikes which were interrupting production and costing the country as much as a billion dollars a year. It was recognized by Congress that disputes over wages, hours, and working conditions could not be totally eradicated in a democratic country which relies on the parties to a dispute to come to their own terms without dictation from government. It was also realistically admitted that disputes for many preceding decades had been left to the respective strengths of employers who did not want unions and of workers who did want them. Some very ugly manifestations appeared in these conflicts. Strikes were often pitched battles in which the workers tried to keep strikebreakers out of plants by force and in which employers tried to starve workers into coming back to work with their union hopes shattered.

ELIMINATION OF RESISTANCE ATTEMPTED

Without attempting the impossible task of preventing all strikes and lockouts, Congress thought that it could narrow the field of disputes by writing a law which would prevent employers from breaking up the labor organizations of workers who desired to form them. That at least might diminish the number of strikes which in the past had been called purely and simply to overcome employer resistance to organization. It would also, by permitting the holding of employee elections, give status to the chosen representatives and thus promote peaceful negotiation with employer representatives.

The Act, as finally signed by President Roosevelt on July 5, 1935, contained in essence two simple points. There, of course, appear in it many sections pertaining to procedure, but the two essentials are these: (1) The Labor Board upon petition may hold elections to discover worker choice of representatives within an appropriate unit; and (2) the Labor Board upon the filing of charges may investigate and, if these charges are substantiated by evidence, may order employers to cease and desist from any of five specified unfair labor practices.

Congress in naming these unfair labor practices was guided by what employers had done in the past when they wished to disrupt a labor organization. Thus the Act holds that an employer must not interfere with the self-organization of workers who wish to join themselves together into a union for collective bargaining purposes; that an employer must not dominate an organization of his workers; that employers must not discriminate against workers for union activity; that an employer must not discriminate against a worker for giving testimony at a Board hearing; and finally, that the employer must not refuse to bargain in good faith with a majority representation of his employees.

Any new law engenders controversy. Back in the last century the Interstate Commerce Act met with as much violent opposition from the railway industry as the National Labor Relations Act did 40 years later. Controversies engender much heat and sometimes lead to misconceptions which are hard to eradicate. It may be well to repeat here a few simple things which the National Labor Relations Act does not do. It does not, as at once assumed by many people, hold any jail or fine penalties over employers' heads. If the Board finds that an employer has violated the Act and orders him to end such violation, such a ruling has no finality until it is reviewed by a Circuit Court of Appeals. Either the employer may petition the Court to upset the Board's order, or the Board may petition the Court to enforce it. In either event the decision of the Court is the final one, and an employer must obey the Board's order only after the Court has so found.

REGIONAL OFFICES ACTIVE

The Labor Board does not decide all its cases by formal methods, nor in fact does more than one case in ten reach the Board in Washington. The original charges of unfair labor practice are first considered in the Board's 22 Regional Offices. Each charge is investigated by a trained Field Examiner, who gets both the workers' and the employer's side of the story. Four cases out of every ten are eliminated at this first stage, because the charges do not contain sufficient merit to carry them further. About five cases out of every ten are amicably settled through discussions in the field between the union, the employer, and the Board's representative. The one case out of ten which does not yield to these informal methods of settlement, must go to a public hearing at which witnesses from both sides are heard under oath. The presiding officer at the hearing is a Board Trial Examiner who sees that all pertinent evidence is admitted and who makes an Intermediate Report containing his findings and conclusions. The stenographic record of the hearing, the Intermediate Report and the exceptions to it made by the employer and/or the union, and a record of the oral argument held before the Board in Washington comprise the entire record of the case, and it is upon this entire record that the Board ultimately makes its decision.

The Board in its seven years has closed the surprising total of more than 40,000 cases brought to it on petitions for elections or by the filing of unfair labor practice charges. No Board of three members could possibly consider the merits of so many disputes. It is to the credit of the Board's field staff—those on the firing line in this difficult relationship—that the vast majority of all controversies arising under the Act are quietly settled in the field. The work in Washington consists in making certain that Board policy is followed in the Regional Offices and in giving consideration to those difficult cases that do not yield to informal field settlement. In its seven years the Board has issued formal decisions, which now number nearly 40 large printed volumes. This may seem rather appalling to the layman, and yet these necessarily lengthy and detailed studies have served over-all to clarify the employer-employee relationship. By the precedents set in these decisions the man who runs a plant has now come to know most of his responsibilities under the Labor Act. By the same token, the worker knows his rights and has learned that he must remain within the bounds of a known responsibility in order to maintain enjoyment of them.

It is a point worth mentioning that the Board's first years were taken up principally with the handling of unfair labor practices. Elections were few and involved no great numbers of workers. During the year 1940 this trend reversed itself. For the past year and a half the majority of Board cases have involved elections; and the unfair labor practice cases, although unfortunately still present in great numbers, show signs of diminishing.

In establishing the present War Labor Board last January, President Roosevelt gave it the power to make final decisions, thus putting on the Board the heavy responsibility of arriving at such wage rates and such a degree of union security as will best serve the public interest, the employer interest, and the labor interest.

CONCILIATION SERVICE

It has been explained above that the National Labor Relations Board has only to consider in Washington those "tough" cases which do not yield to settlement in its field offices. In a somewhat parallel manner the 12 members of the National War Labor Board do not have to consider all wage and union security disputes in person. The Conciliation Service handles disputes in their early stages and only certifies to the War Labor Board those which offer such difficulties that one or both parties will not surrender their strongly held positions. In addition to the many cases which the Conciliation Service settles before they reach the War Labor Board, the decisions of the latter agency are quite widely accepted as precedents by other employers and by unions. In particular should we mention the WLB decision in the "Little Steel" cases where the wage and union security policies were specifically described as a precedent for others to follow.

The functions of other agencies supplement each other. The Fair Labor Standards Act intends that workers in the lower-paid groups should be guaranteed a minimum wage. The National Labor Relations Act upholds the right to worker self-organization and collective bargaining. The Conciliation Service offers its good offices to disputants who may be brought to agree through getting together. The War Labor Board under emergency war powers sees to it that disputes are finally settled in the interest of uninterrupted production.

The National Labor Relations Act, by preventing interference with worker organization, has certainly promoted the device of collective bargaining. In these days when it is so necessary for management and men to keep at work under known terms of employment, the existence of signed contracts serves a most useful purpose.

Development of Army Camp Planning

A Hundred and Sixty-Five Years of Progress in Standards for Military Establishments in the United States

By CLARENCE G. BEARDSLEE

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THE transition from a collection of crude shacks huddled together for protection, to the highly organized troop city of today illustrates the progress of army engineering. In all periods of our nation's history, the location of army camps, their size and accommodations, have been dependent upon the needs of the hour. During periods of greatest urgency it becomes necessary to provide facilities on short order, with little measure of future needs. The present emergency has produced quarters for our fighting men on an unprecedented scale.

WHEN faced with the huge engineering problem of providing shelter and all the other complex facilities required for the comfort and training of millions of soldiers for today's armies, it is difficult to remember that it has been but a few short years since the first American troops were housed in our territory. Prior to the Revolution, the introduction of barracks was opposed on the theory that the soldier was thereby estranged from the citizen and made into a tool of despotism. "A standing army is dangerous to liberty," said the Colonists, and defined the few existing defensive measures as protection against the Indians.

When in December 1777, Washington retired to Valley Forge and found himself in an undeveloped, densely wooded country, his soldiers were completely uninstructed in the principles of camp construction. They set to work as best they could with the meager knowledge and few tools they had. Each regiment cut fuel and such logs as would do for building, reared huts, covered the few windows with oiled paper, and laid out streets. The brigades stretched between Trout and Valley creeks in the shape of a "V." Camp sanitation was almost an unknown thing and the soldiers gave little thought to cleanliness. The carcasses of dead horses lay about the camp, and human waste was not even buried. The huts had no chimneys, were poorly ventilated, and were crowded beyond capacity. This was a first, typical attempt at camp construction. Unfortunately, it was many years before any great progress was made.

After the Revolution, lonely garrisons began to come into existence along the border from Fort Pitt to Vincennes. Designed as "permanent" posts, they were built without guidance by soldiers and officers. Generally the fort was erected in stockade form. Its rectangular fence of logs, pointed at the top and loopholed for the flintlocks and iron and brass cannon, was reinforced at the four corners by blockhouses. The enclosure was divided into two parts by a high stockade fence similar to the outer one, so that the occupants could retreat from one side to the other. One enclosure contained the guardhouse and parade, the other the quarters of the officers and men, and the magazines.

Officers' quarters were log shacks of two rooms, one to an officer, while in the small barracks the enlisted men huddled together over open fireplaces. Supplies came in by boat or caravan at rare intervals. During the harsh and monotonous winters the chief source of entertainment was rum.

QUARTERMASTER'S DEPARTMENT ESTABLISHED

Out of a welter of legislative acts occasioned by the War of 1812 there arose for the first time a systematic organization for the provision of barracks, the Quartermaster's Department. The act marked the passing of the military agent, but because of its numerous and confusing riders it was frequently referred to as "An act for the speedy enrichment of contractors, and the periodical starvation of the troops of the United States."

After 1812, the War Department began to link up the northern and southern frontiers with a chain of posts which continued to be designed by individual officers. One of these posts was Fort Snelling, constructed in 1820 as a protection against Indians. It was located on a 6,000-acre reservation at the junction of the Mississippi and Minnesota rivers, 791 miles upstream from the main depot at St. Louis. The defenses and some of the storehouses and shops were of stone, but the quarters were single log huts. A stone wall enclosed the irregularly shaped bastioned redoubt, somewhat in the shape of a rhombus.

Fort Leavenworth, a second link in the chain, was established in 1827 on the Iowa-Missouri border (see accompanying plan). This post was extremely unhealthful, and a large part of the command was prostrated by malaria in the first year. The plan of the post resembled an "L." Water was plentiful, but sanitation was almost primitive. Forty years later, all camp refuse was still being carted a mile from the garrison to be thrown into the river.

A third post, Jefferson Barracks, was established in 1827 for the protection of St. Louis, then a trading village. The greater part of the barracks was erected by the soldiers. Built in a rectangular shape to accommodate 22 companies, the post occupied 1,700 acres. For years, water for domestic use was collected from the Mississippi and given no treatment except a short settling period. In 1870 the medical officer reported that St. Louis sewage was being dumped into the river about 9 miles upstream, and commented stoically, "Ordinarily the water causes diarrhea to those first using it, but in a short time it becomes a healthy and highly acceptable drink."

CULVERT FOR A MODERN CAMP ACCESS HIGHWAY

Miles of First-Class Roads Are Now Needed for This Purpose

A MODERN WATER TREATMENT PLANT SERVES A LARGE SOUTHERN ARMY CAMP

Little new construction was undertaken until 1846 when, with the acquisition of 960,000 sq miles of territory from Mexico, Congress allowed the War Department to garrison new posts at selected spots beyond the old line of forts. At this time the Army numbered scarcely more than 8,000 widely scattered troops.

Fort Kearny, the first of the new posts, was established near the head of Grand Island, 310 miles from Fort Leavenworth. Farther out, 337 miles west of Fort Kearny, an old adobe trading post at the mouth of Laramie Creek was bought and renamed Fort Laramie. Beyond South Pass were private posts at Fort Bridger, Fort Hall, and Fort Boise. In addition to these landmarks on the trail to the Pacific, approximately seventy smaller posts were dotted over the plains.

CAMPS REFLECTED TRAINING OF CONSTRUCTING OFFICERS

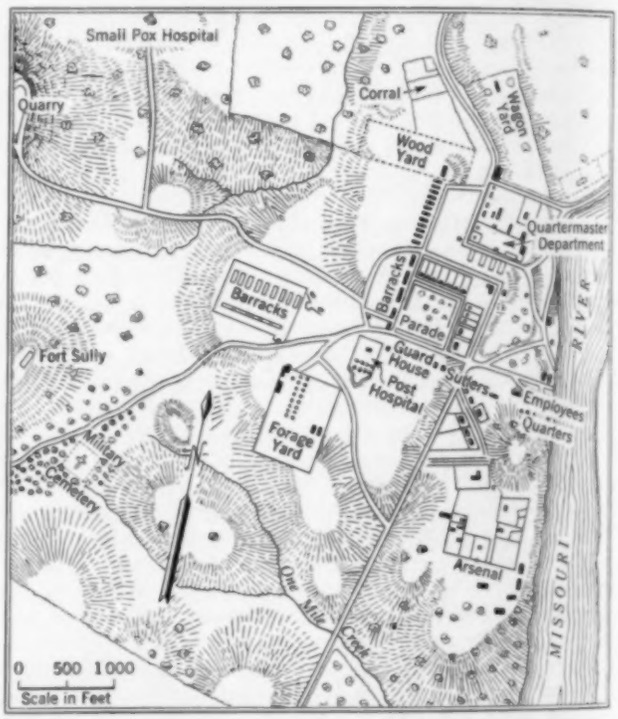
In the construction of the forts, the soldiers were merely halted at a likely spot and given tools and the open country. There was no appeal to Washington, no expectation of a Congressional appropriation, no influx of materials, equipment, and skilled workmen. As a result, the camps were as varied in character as the men who lived in them.

All the camps of the period were arranged so that troops could pass quickly from the fort and form their line of battle without confusion. "The art of fixing a camp in modern times," wrote Lt. H. Wager Halleck of the U.S. Engineers in his *Elements of Military Art and Science* (1846), "is the same as taking up a line of battle on the same position." This one sentence practically summed up all that most officers knew when they ordered their men to work. "While our artillery is nearly six times as numerous as in ordinary armies," Lieutenant Halleck observed, "our engineers are not more than one-half what ought to be their proportion in a war establishment. The buildings at nearly all the frontier posts continue to be built of logs or flimsy frame, put up hastily and for temporary occupation, and in need of constant repair."

An attempt to regulate the method of camp construction was made for the first time in the nation's history in 1858 by Don Carlos Buell, Assistant Adjutant General. Under his supervision, plans and directions for the construction of quarters, hospitals, and guardhouses, and for the arrangement of a camp were drawn up. This material, together with minute tables of estimates, specifications, and other data, was printed in 1860 at the Government Printing Office and was declared by the Secretary of War to be the authorized regulations for such construction. The thick volume was never issued, however, and even its existence remained unknown to all but a few persons.

An example of camp construction of this period was Fort Lyon, built in the winter of 1859–1860 by four companies of cavalry. The post was so located on the flat valley of the Arkansas River that the rains created seas of mud. A year after its construction, General Sherman wrote: "The buildings are all of single story, with flat roof of cottonwood timber, covered with dirt. The walls are of stone, got out of the neighboring hills, laid up roughly with mud. The men's quarters have no floors . . . . The post is about as good as could be expected under the circumstances, but not fit for troops."

With the outbreak of the Civil War, the problem of troop housing was attacked on a larger scale than ever before. The mixed Northern levies came into camp in the vicinity of Washington so rapidly that all was confusion. Hordes of inexperienced soldiers and officers roamed about their tented cities. Few knew anything of maneuver, of guard and outpost duty, of discipline, and sanitation. In the camps about Washington and Alexandria, some of the soldiers slept on the ground, some on cots. Malaria swept Fort Washington, already notoriously unhealthful. As winter came on, the soldiers built wooden frames around their tents, collected stoves, and shifted for themselves. Certainly few could congratulate themselves on being better provided for than Washington's men at Valley Forge, three-quarters of a century before.



FORT LEAVENWORTH, KANSAS, ESTABLISHED IN 1827, TOOK ITS WATER SUPPLY DIRECTLY FROM THE MISSOURI RIVER

FORT SEDGWICK AN EXAMPLE OF CIVIL WAR CAMPS

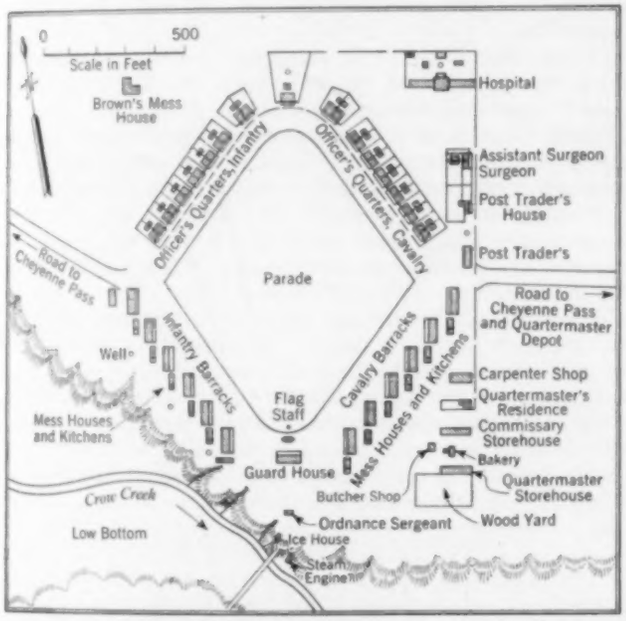
The Civil War brought with it, as wars do, many new developments, but new methods of camp construction was not one of them. In 1865 General Sherman wrote of Fort Sedgwick, which had been built in the preceding year: "The post is on the south bank of the South Platte and therefore on the wrong bank for the railroad,

which is building on the north bank. The post was first built of sods, and now looks like hovels in which a negro would hardly go. But here is progress—three sets of company quarters made of adobe walls, with good doors and windows, but the floors and roofs are of earth . . . . We have no business to put men out here unless we give them food and shelter, and all things but sand and water must be hauled from one to four hundred miles."

Similar criticism might well have been directed at many other posts made necessary in the great West by the constant forays of Indians, who numbered some 375,000. In this category belongs Fort Russell, a plan of which is reproduced herewith. From 1865 to 1880, while the Army steadily diminished until its effective strength was below 20,000, new forts had to be built, often with scarcely a hundred men. The smaller outposts measured only 800 by 600 ft, and the smallest posts consisted of nothing more than tents and shacks in isolated places.

WHEN PRECEDENT USUALLY GOVERNED

There were no laws or regulations with regard to the arrangement of a post, and an officer charged with new construction usually copied the arrangement of an older establishment with which he was familiar. In the West, the standard method of arrangement was to distribute the buildings around and fronting on a rectangular plot of ground used for parade. Variations on this method were sometimes attempted, with a marked lack of beginner's luck.



OLD FORT RUSSELL IN WYOMING TERRITORY WAS BUILT AROUND ITS PARADE GROUNDS

A plan was proposed for Fort Wingate, N.Mex., according to which the buildings radiated from a common center like the spokes of a wheel, but the costs mounted so steeply that the impractical design was soon abandoned. Fort Richardson, Tex., was another proof that energy and inexperience sometimes produce dubious results. The post was begun at Buffalo Springs and much expense was incurred in bringing in materials and labor. Then suddenly some one discovered that the water supply had failed and that timber was not available, and the whole project was moved to another site.

In 1870, the Assistant Surgeon General of the United States, John S. Billings, observed in a report on barracks

STEEL OVERPASS CARRIES ACCESS RAILROAD SERVING AN ARMY CAMP

and hospitals: "It has been said that we have the best fed and the worst housed Army in the world, and the statement seems more nearly correct than such generalizations usually are. The ultimate cause of the defect is ignorance. . . . Frontier posts are intended or supposed to be permanent. Although called 'forts' they are really only barracks or cantonments, intended to accommodate from two to six companies. They are usually about one-half the size which they should be, if intended as permanent quarters."

"A not uncommon error in the construction of barracks," Billings reported, "is making them too wide . . . . Dormitories 40 ft square and 10 ft high are impossible to ventilate properly. They should not be more than 24 ft wide . . . . Each soldier should have at least 600 cu ft air space in barracks, but of 151 posts surveyed, only at 37 was the air space found adequate.

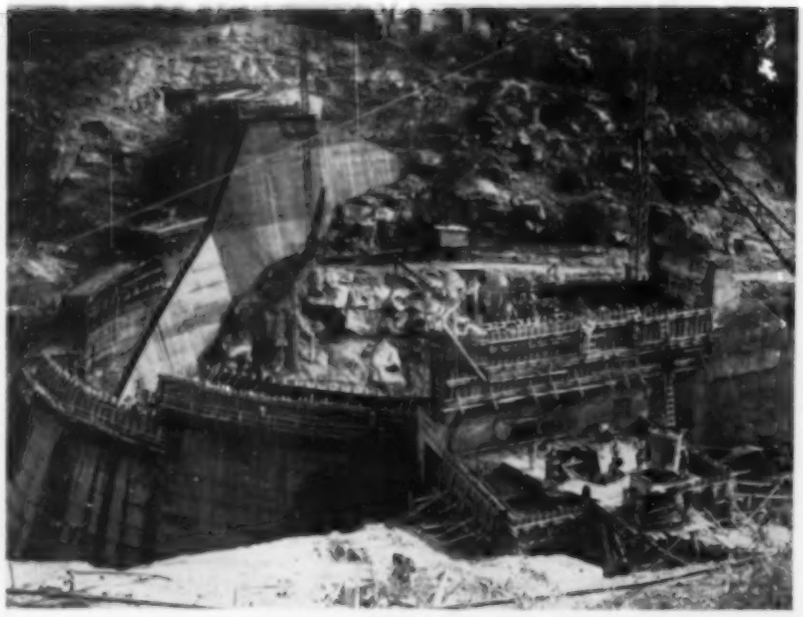
"When hospitals were ordered by the War Department they were usually built by contract without intelligent supervision, no medical man being consulted as to the specifications. . . . The bad sanitary conditions of barracks gives rise to continued fevers, diseases of the respiratory organs, and tuberculous afflictions."

NEED FOR MORE CAREFUL PLANNING OF CAMPS FINALLY REALIZED

This report was written at the lowest point in the Army's history, when the armed forces numbered less than 20,000. Eleven years later, with the establishment of the School of Application for Infantry and Cavalry at Fort Leavenworth, the Army began to undergo a slow renaissance. Standardization of camp construction was initiated, aided by recommendations of the Endicott Board, in 1881, for the reconstruction of coast fortifications. Great advances were beginning to be made in training and planning when everything was pigeonholed in the confusion of suddenly having to train 216,000 men for the Spanish-American War.

Despite the request of General Miles that the volunteers be placed in small camps in their own states for primary training, while larger camps could be carefully selected, two concentration points were designated for the poorly equipped soldiers—Camp Thomas at Chickamauga, Tenn., and Camp Alger at Falls Church, Va. The inevitable happened. More than 76,000 men were sent to Camp Thomas, although its capacity was only 20,000. Camp Alger was even worse. The results of these conditions were not slow in making themselves felt. Typhoid fever raged, and the efforts of numerous home-town doctors to correct the problem of sanitation failed, simply through lack of proper training.

The subsequent experience of the Army in Cuba, Puerto Rico, Hawaii, Guam, the Philippines, and China made Congress realize the importance of military education in



MODERN CAMP REQUIREMENTS FAR EXCEED THOSE OF FORMER TIMES
Army Engineers Rush Work on a Dam to Impound Water for a Newly Constructed Camp

times of peace. The "garrison school" was established in 1902, followed by special service schools. In the next year plans were made for National Guard camps. The organization of the War College in 1903, and the nation-wide maneuvers of 1904 were further steps in preparing the Army to house great numbers of men in times of emergency.

CONSTRUCTION IN WORLD WAR I

When once more the nation took up arms, this time to wage a World War, the sad experience of the training camps in the war with Spain was used to some advantage. In April 1917, the Council of National Defense saw that the Quartermaster Corps would have difficulty handling the enormous building program, and created an Emergency Construction Committee, which drew its executives from the ranks of large contractors. Sites chosen for the cantonments were as a rule near Army posts already in existence (five were west of the Mississippi, and one on the West Coast), none of which had housing for a complete division, then fixed at 979 officers and 27,082 enlisted men. At each of the camps 48,000 men were to be housed for general training, leaving the final polishing to be done in France.

Construction was begun in June 1917, and contractors on a cost-plus basis rushed the work, meeting induction dates with few delays. Construction problems never before encountered by the Army were solved. Barracks and mess halls, service offices, recreation centers, water systems, telephones, and other equipment were installed in spite of shortages and handicaps. The management and efficiency of the military service were far ahead of anything the nation had ever accomplished, and at the close of the war almost two million men had been trained in the camps and sent overseas.

However, there were many dark spots in the picture. The losses from disease were far above what they would have been with completely adequate housing, and undue hardships were incurred because of insufficient preparation. It is only by comparison with present-day standards that one sees how little was used of the vast experience the Army had acquired in its years of activity.

In a very real sense the housing of the present Army represents a complete departure from all that has gone before. By July 1939, the active Army had dwindled to approximately 174,000 enlisted men scattered over 130 posts, camps, and stations in the continental United States, plus five overseas garrisons. World War I housing had almost ceased to exist, and that still in use had deteriorated to such an extent that maintenance costs were prohibitively high. The conviction that a standing army is dangerous to liberty had led liberty into an extremely perilous situation.

PRESENT CAMPS REPRESENT GREAT ADVANCES

Troop housing at the beginning of the present national emergency was constructed for the purpose not only of sheltering troops but of facilitating their instruction in modern mechanized warfare. In the past, sites for camps had been selected with a view to the defense of an area, as in the case of frontier posts, or for replacement training centers, as in World War I. Up to the first of this year, when a censorship was placed on news of Army construction, more than fifty huge camps had been built, providing housing for almost a million and a half men. These camps, largely completed before the country was actually at war, were located where essential field maneuver training could be provided, and where large bodies of men could be concentrated for any large-scale action in, or from a section of, the continental United States.

Prior to the outbreak of war, armored-division training establishments were located as far as possible from civilian centers, on land not good for agricultural production, and adequate for strategic and military purposes. On the contrary, sites for standard cantonment, tent camps, reception centers, and replacement training centers were located preferably near large towns or cities so that the soldiers would not be cut off entirely from civilization, and so that the problem of supply would be simplified.

With the prospects of an army several times larger than that anticipated two years ago, it is likely that new construction will be of a much more temporary nature, and the location of new camps will be determined largely upon the consideration of strategic importance. The most obvious change in design within the past year is the restriction of the parade ground. In many instances this area is now superfluous since mechanized equipment is given room for maneuvers in specially selected zones of the reservation. Defensive works, such as fortifications and fixed artillery, have a much less important part in camp design than ever before. However, the old concept of planning to allow the swift movement of troops to other areas of the camp, or from the camp, mentioned by Lieutenant Halleck nearly a century ago, has been employed with great effect in the triangular division camp, which from a tactical viewpoint is a tremendous advance over the old square division type.

ENORMOUS PLANTS ESTABLISHED

The great changes occurring within the past quarter of a century in the standards for facilities of public welfare have made the modern camp a highly complex organization. Complete water supply systems, heating plants, paved streets, lighting systems, elaborately equipped hospitals, laundries, bakeries, giant warehouses, pipe lines, sewage disposal plants, garages, and mammoth motor repair shops are only a few of the items of construction never before provided on such a scale.

It is a far cry from Washington's miserable quarters at Valley Forge to the troop city of 1942. Military costume and equipment, troop housing, the method and purpose of warfare have changed beyond recognition. The essence of the present conflict is change, development, movement. Therefore it is well to remember that what has not changed, but grown finer and stronger as the result of a century and a half of victory, is the courage and intelligent versatility of the American soldier.

Texas Road Construction in the Emergency

Use of Local Materials and Hand Labor Overcomes Priority Restrictions

By FRED BURKETT, M. AM. SOC. C.E.

SENIOR RESIDENT ENGINEER, TEXAS STATE HIGHWAY DEPARTMENT, FORT WORTH, TEX.

TO prevent interference with the allocation of critical supplies and equipment to war production is essential today. So the Texas Highway Department has called upon its engineers to develop designs and methods for the construction of necessary roads with available materials. Their experience shows that local materials and simple equipment can solve the problems presented by wartime restrictions. Methods and results are described by Mr. Burkett. His paper was first presented before the 1942 Spring Meeting of the Texas Section in Austin.

IT has become necessary of late to revise the plans for many projects under construction by the Texas State Highway Department so as to eliminate critical materials. Numerous other projects which we propose to construct without the use of priority materials are in the planning or conception stage. Obtaining reinforcing steel is the only difficulty, and we are proposing the use of numerous substitutes. Our Austin office, especially the Bridge Division, has approached the solution of the problem by designing arch spans and other structures of masonry, and by allowing the minimum amount of steel where its use is necessary.

For example, it has been discovered that a highway culvert can be rationally designed with only a fraction of the steel required for our usual standard design. A concrete bridge rail has been developed which has all the desirable features of our usual channel iron rail but avoids the purchase of the channels. Several hundred tons of cast-off oil-field sucker rods have been acquired to be used as a substitute for the regular deformed bars. These rods, whose diameters range from $\frac{5}{8}$ in. to 1 in., will be used to reinforce concrete for widening culverts and for heavy girder spans. Office and field engineers are cooperating to develop designs which will conserve this salvaged material and adapt its use to the limitations of economical construction. Grouping of bars in the bottom of girders, welding of splices, and the use of higher bond and diagonal tension stresses are procedures that make this possible.

Extensive use of arch spans for both culverts and large structures is planned. Where lack of headroom will prevent the use of arches for culverts, the side walls and wings will be constructed of masonry and a concrete top slab poured with sucker-rod reinforcing. Serious consideration has been given to the use of cedar logs for a top slab because of the abundance of cedar in most of the state. Some culverts with a laminated creosote timber deck have also been designed but will probably not be used until the supply of sucker rods is depleted.

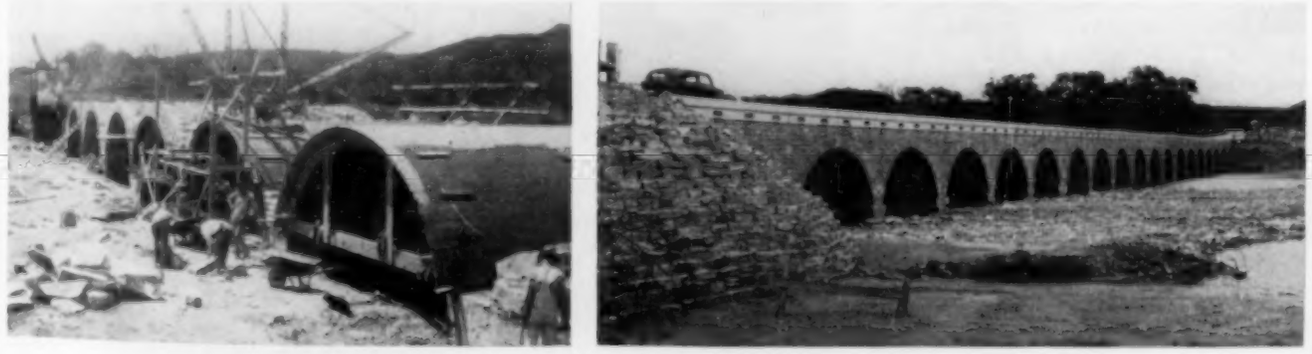
Construction of a masonry arch bridge across the Brazos River at Glen Rose has been considered. Because of the proposed construction of a power dam at Bee Mountain by the Brazos River District, the roadway grade of this bridge would be 65 ft above the stream bed. The design proposed would feature five circular arches of 100-ft span with the springing line at about the elevation of the stream bed. The chief objection to this design is that several years might be required for the work; on the other hand, it might be several years before a steel truss would be available for this crossing. Contractors have indicated an eagerness to undertake the masonry type of construction.

NOT A NEW PROBLEM

The elimination of critical materials from the design of structures is not a new problem in the Texas Highway Department. At Wichita Falls and Fort Worth, it has sponsored some fifty WPA projects since 1935. On about 300 miles of state and federal highways the total cost was in the neighborhood of $4,000,000. On these projects all materials and equipment were critical because so little money was provided for them.

Of the WPA money spent on these projects, 85% was allowed for labor and only 15% for materials and equipment. To that 15% was added the state's share of the cost, this last averaging considerably less than 50% of the total. Very little road work can be done in a reasonable way without providing at least 50% of the cost for materials and equipment, and on the ordinary contract job the non-labor cost runs about 90%.

When work was first started it was quite a problem to get hand tools for the 200 men assigned to the job. It was also most difficult to get even enough lumber to build a tool shack. The borrow pits were plowed with a



BRAZOS RIVER ARCH BRIDGE, POSSUM KINGDOM PROJECT, ERECTED BY HAND METHODS
Construction View, at Left, Shows Derricks for Hand Hoists

farm team and the subgrade was prepared by plowing and hand casting the material from the trench onto the shoulder. The gravel was spread and fine graded by hand. A few trucks were available for hauling gravel.

Critical materials have been eliminated by the extensive use of hand labor methods of construction, improving on the methods of early times before the invention of our modern materials and equipment. Every effort has been made to locate materials near the work which could be produced by hand labor. Thus the high cost of shipping in finished material is avoided.

Many of the projects selected have been those which were adaptable to hand-labor methods and to the use of local materials. Clearing and grubbing projects, light grading and flexible base work, construction and extension of culverts and concrete bridges, curb and gutter work, and widening projects in general are examples. The use of structural steel has been eliminated almost entirely. Asphalt work, steel bridges, and other construction operations requiring a high percentage of materials and equipment have been avoided.

CULVERT ON CANYON ROAD, PALO PINTO COUNTY
Has Masonry Wings and Walls, and Concrete Top Slab

Concrete and masonry work is especially favored when the aggregate can be produced by hand labor from nearby sources. Bridges and other major structures have been constructed in this way. Cement, lumber, and reinforcing steel are the only materials required, and of these steel is the only one on the critical list. Posts for shoring and falsework are usually cut from trees near the site. A concrete mixer is the only equipment required. Where piling is needed, a homemade skid-rig driver of the yo-heaver type has been used.

Construction of a flexible base course is also very well adapted to this method when local material can be found that is suitable either in its bank-run condition or after hand processing. The hand preparation consists of plowing and windrowing the material in the pit, followed by sledging and hand loading with scoops into trucks. On the road, a tractor and grader are used to prepare the subgrade and spread the materials on the roadway. In this way as much as 1,000 cu yd of base material has often been placed in an eight-hour day.

A WEALTH OF LOCAL MATERIALS

The diligent search always made for local materials often has resulted in the discovery of excellent deposits previously overlooked. For instance, in 1941 in Johnson County an excellent iron ore deposit containing millions of cubic yards was discovered. This material is now being used to surface a federal highway. In Wilbarger County the need for local material resulted in the use of soft sandstone for a flexible base. This stone is handled in the pits and on the roadway very much as ordinary caliche. It has been found widely in North Texas where no other local material occurs and has been used on many miles of highway with very good results.

A great amount of short-haul earth has been moved with fresno teams—fortunately mules have not yet been put on the critical list. Although earth can be moved at less cost with scrapers or other mechanical equipment, the fresno method is suggested where machinery is not available. Earth that is beyond the range of fresno haul has been moved by hand-loaded trucks in much the same manner as the flexible base. In general, earth moving does not as economically fit into the program as some of the other work mentioned.

Some large projects have been undertaken on this program. A 28-mile section of State Highway No. 16 at Possum Kingdom in Palo Pinto County is nearing completion. This project was well adapted for design without critical materials except for 40,000 cu yd of solid rock excavation in a canyon near the Brazos River. After the rock had been drilled by hand labor, and shot, it was moved with a bulldozer and a $1\frac{1}{4}$-cu yd shovel. The cuts ranged up to 30 ft deep and the fill ran to 50 ft in height. The culverts were constructed with masonry footings, walls, and wings, and with a concrete top slab containing a minimum amount of reinforcing steel.

Bank-run material for the flexible base course was closely controlled by the usual field laboratory methods. A light double asphalt surface treatment was placed on

LOOKOUT POINT, PALO PINTO CANYON
Masonry Railing Utilizes Hand Methods

MASONRY PIERS AND REINFORCED CONCRETE GIRDER SPANS ON BASQUE RIVER BRIDGE, HIGHWAY 108
35-Ft Spans on 35-Deg Skew

25 miles of the section and it is now a finished roadway in excellent condition. There is an abundance of hard limestone in this locality which could have been crushed for a base course, but it was not used because of the expense of providing the dynamite and the crushing equipment. However, 6,000 cu yd of asphalt aggregate were produced from field stone by a small crushing plant.

A MASONRY ARCH BRIDGE WITH FEW CRITICAL MATERIALS

On this Possum Kingdom project a masonry arch bridge was constructed across the Brazos River about one mile below the dam. No critical materials were used except sheet piling on the foundation work and a small amount of reinforcing steel in the spandrel walls and curb rail. There are eighteen 20-ft circular arch spans, and the roadway grade is about 14 ft above the stream bed. The bridge was designed for an overflow which has occurred four times since the work was started, with no resulting damage. The roadway is 24 ft wide, paved with 4-sack concrete 6 in. thick having no reinforcement. The haunches were backfilled with 1-sack pit-run concrete. This solid block of masonry eliminates the possibility of damage to the roadway from scour during overflows. The piers are founded on solid sandstone about 9 ft below the stream bed. As the material from the ground line to the bedrock is composed of an open gravel, it was necessary to drive and shore sheet piling for all the piers.

Scrap sheet piling suitable for the purpose was purchased from the contractor who had completed the Possum Kingdom Dam. The piling was driven and pulled with a No. 5 steam hammer which was handled by a $^{3}/_{4}$-cu yd crane. Hard limestone was quarried for the masonry from nearby ledges that were very uniform in thickness, and the stone was set in place with hand hoists mounted on small derricks. Mortar was of 1:3 mix and ran about 10% of the total masonry volume.

Concrete aggregates were obtained from the stream bed, which contains excellent sand and gravel requiring no washing. No transportation was required for these aggregates, because the material could be scooped directly into the mixer. It was screened where a batch design was required. This bridge was constructed entirely with WPA supervision and labor, except for one crane operator who was on the Highway Department payroll. This project shows that important work can be done with a minimum use of critical materials and with the maximum use of local materials.

Machinery and machinery parts thus far have presented no great difficulty in our construction program. This is due in great part to the foresight and resourcefulness of our Maintenance Department and its machine shop. We were very fortunate in having a fair amount of new equipment on hand when the emergency started. The repair department has shown great ingenuity in substituting and making parts not obtainable under our low priority rating. Leased equipment is becoming more difficult to obtain, and the rentals have risen sharply. This is especially true in the vicinity of Army camps and other large defense works.

PROGRAM NOT TO INTERFERE WITH DEFENSE

Several access roads and several of the strategic highways which had a high priority rating have been constructed, but on these as on all our projects an effort was made to conserve critical materials and equipment. The WPA program has been very valuable in promoting construction methods and design that do not require the use of critical materials. With careful use of the resources on hand, according to the methods outlined, we believe that our highway program can be carried on without serious handicap, and in such a way as to prevent interference with the national defense effort.

Some Aspects of Highway Maintenance in Peace and War

By CHARLES R. WATERS

DISTRICT ENGINEER, NEW YORK STATE DEPARTMENT OF PUBLIC WORKS, DISTRICT 5, BUFFALO, N.Y.

LOW total cost of an engineering structure, which after all is the main objective, frequently depends more on the upkeep than on the original expenditure. Especially is this true of our highways, which must be used extensively and for long periods. Accordingly many engineers who have burned the midnight oil in studying the problem Mr. Waters covers, will find his experiences in western New York State enlightening. It deals with manufacture and reconditioning of signs, with lane marking practice, and with blackout precautions. This paper was given before a 1942 meeting of the Buffalo Section and also before the North Atlantic Highway Association in Philadelphia.

NOWADAYS the highway engineer is called upon to supervise many operations in the normal course of his work. Both construction and maintenance offer problems for his solution. The experience of the New York State Department of Public Works at its Buffalo Office (District 5) may prove helpful to other engineers faced with similar questions. In particular, mention may be made of the treatment of signs to control, direct, and inform traffic; markings to delineate pavement lanes; and a few special problems due to the war.

If we are to have satisfactory traffic signs they must be well manufactured in the first place and kept in good condition during service. The most important point we have learned in the manufacture of ordinary metal highway signs has to do with the steel of which they are made. Such signs are subject to destructive agents other than weather—they are targets for bullets and stones; they are often hit by automobiles; and they are severely treated by snow plows.

SUITABLE BASE MATERIALS FOUND

After much experimenting with what we call the "bullet test," we found that so-called Bethanized steel sheets —manufactured by the Bethlehem Steel Company—in which the zinc coating is applied by an electrolytic process, did not rust when hit by bullets or missiles. Here, then, was the product we needed. Recently, several other manufacturers, such as the American Rolling Mills Company, the United States Steel Corporation, and Republic Steel Corporation, have produced sheets which compare favorably with these.

In manufacturing metal signs, the sheets are cut to size and shape, drilled for reflector buttons (if necessary), cleaned, and then given a phosphate coating by a process known as "bonderizing." This makes for paint adherence and rust inhibition. Paint ordinarily does not adhere well to zinc. In bonderizing, three tanks are employed —bonderizing powder, water rinse, and chromic acid bath (to re-acidify the metal).

After bonderizing, the steel is given two or more coats of synthetic enamel, either by dipping or spraying. After each coat the signs are baked in a gas-fired oven at about 225°, or approximately the same as the oven of an ordinary cook stove.

The symbol or message is placed on the face of the sign by the silk-screen process. This is a great labor-saving device. The time consumed in lettering a sign is a matter of seconds, up to three quarters of a minute, depending on the size of the sign. A large sign, which would take two or three hours to letter by hand, can be done with the silk-screen process in less than a minute. The screen acts somewhat like a stencil and the thick paint—a sort of paste—is forced through by means of a rubber squeegee.

Signs to be reflectorized are marked for the button reflector holes by the aid of a metal stencil, and then about 40 sheets are piled one on top of another, and holes drilled by the use of a large radial drill. This machine cost about $5,000. When less than ten signs of one type are on order, the holes are made by the aid of a small punch press. Pans are made for the backs of reflectorized signs, and final assembly is accomplished by inserting the reflector buttons and bolting the parts together.

Reflector buttons have been greatly improved within the last few years. Under our specifications the reflective value of $\frac{1}{2}$-in. buttons has been increased from a unit of 5 to a unit of 12. This means that buttons may be seen at a distance of 2,400 ft, a gain of 1,400 ft over the old type. Use of reflector buttons adds greatly to the

ASSEMBLING REFLECTORIZED SIGNS INDICATING SPEED ZONES

CORNER OF TEST YARD—VARIOUS SIGNS AND MATERIALS UNDER OBSERVATION

cost of highway signs. A plain sign worth $3.00 without buttons, costs $12.50 when equipped with 200 half-inch buttons. This represents an increase of 400%.

Besides baked enamel signs, porcelain enamel signs are widely used for outdoor signing purposes—for example, at the new Rainbow Bridge at Niagara Falls. These, of course, are satisfactory, but the first cost is nearly twice that of the baked enamel signs and they cannot be reconditioned. Bullets chip the enamel and it is difficult to cover the bare spots. However, California, which is one of the most progressive states in the development of highway marking, uses porcelain enamel signs, and I believe the new signs on the Pennsylvania Turnpike are of this type. The Peace Bridge at Buffalo uses cast aluminum signs with raised letters and border. These have proved eminently satisfactory, and strange as it may seem, few of them have been stolen.

ADVANCED PRACTICES IN RECONDITIONING

Practically the same process is used for reconditioning signs as for manufacturing them. Old signs are straightened; the paint is removed; the metal is bonderized and repainted. Formerly route markers were painted by hand, but because they are embossed we are now able to use the hand-roller process just described, and thus save a great deal of time and money. We also have a motor-operated roller coating machine for the rapid painting of embossed signs in large lots.

Reflector buttons deteriorate with use, and before placing them again in signs we test them thoroughly. This new testing is somewhat similar to the old-fashioned method of candling eggs, but is based on the principle of the photoelectric cell. By holding the button against the aperture in front of the instrument, a definite measurement of the visibility can be read in numerical terms on the face of a galvanometer.

Heavy cast-iron signs such as are seen along the roadsides in New York and many other states are now painted in the field by mechanical spraying and a small hand roller. This is much more economical than the old method of doing the work with a brush by hand.

For further field-testing purposes, we have exposure racks in our District highway yard. Panels and signs have been exposed to the weather for periods of as much as nearly six years. Some of these are in good condition and some have failed. The test racks show that practically all the steel panels that are not zinc-coated are rusting. We are trying to follow the precepts indicated by these and other tests, and we expect that signs manufactured and reconditioned as described, will have, unless damaged, a life of five or six years, which is all that can be expected of baked enamel steel signs exposed to the variable weather conditions of northern regions.

Under present methods the cost of our highway signs runs to about $75,000 a year. If the old hand methods of reconditioning were still in force, and new signs were bought in the open market, the cost would total at least $135,000 a year. According to our estimate, this indicates a saving of about $60,000, effected by the use of modern methods.

Recently we received instructions from the Public Roads Administration, and also information from the National Bureau of Standards, that neither steel nor zinc would be available for signs during the emergency. This means that for the time being we will have to lay aside the knowledge we have gained about the manufacture of metal signs and go back to the old-fashioned wooden ones.

Although this paper does not attempt to deal with the placing of signs, it may be noted that maintenance engineers should reexamine the location of signs to see that they are in places where they are subject to the least abuse. Foremen should be advised to spot-paint signs when they are damaged, and in general to protect and preserve them as much as possible.

TRAFFIC LINES STILL MUST BE MARKED

For the marking of traffic lines on pavements, we developed in western New York a machine or apparatus capable of being used either attached to the rear of a truck or hooked to the center of a pushmobile. The paint valves of this machine are operated by air. It has three sets of nozzles, and the equipment has averaged in excess of 30 miles of lane marking a day in covering 1,800 miles of pavement. The high mileage for one day was nearly 60 miles.

It is worth noting that the apparatus is equipped with a variable drive, which makes it possible to duplicate dash lines, placed as early in April or May as weather permits, when they are repainted after Labor Day when traffic has decreased. It also has a paint strainer which eliminates delays from clogging of paint lines.

There is a distinct economic advantage in using broken lines. Five gallons of paint per mile are required on dash lines 4 in. wide, against 12 to 15 gal on solid lines. During 1941 our average cost on 2-lane pavement work were $9.04 per mile, of which $6.43 was for paint and $2.43 for labor, including truck charges and engineering services.

Signs on pavements marked "R.R." and "Stop" are placed by means of large steel or wooden stencils, using spray-gun equipment. Our estimates show that we save the equivalent of $1.50 per gal of paint when it is applied through the use of spraying equipment and stencils rather than by brush methods for these special markings.

The question of paint formulas is one which, for proper handling, would require altogether too much space. We have been conducting numerous experiments comparing the so-called California type of paint and the oleoresinous type, which is the one generally used in New York State. It is our conclusion that the formulas for durable paint are now well known, but the factor of visibility is not being given sufficient attention.

Visibility at night is highly important because much depends on whether or not lines on pavements can be seen after dark and during rain storms. I believe greater weight should be given to this phase of the subject by those conducting experiments, writing specifications, and making purchases. Pennsylvania places emphasis on this feature and specifies a required amount of visibility for both day and night conditions.

The Province of Ontario, Canada, uses glass spheres or beads in paint. These are highly reflective at night. From C. W. Robbins, district engineer in the provincial highway department, I learned recently that their lines are lasting one and one-half years. Our experience with this type has not equaled that of our northern neighbor.

Extensive field experiments conducted in Indiana in 1941 showed that out of 11 white traffic paints, the best and the poorest belonged to the oleoresinous type, of which the New York type paint is a specimen. The California type was between these two groups with respect to durability at the end of 11 months.

BLACKOUTS CREATE PROBLEMS

We have new problems to meet. One subject now assuming importance is the consideration of those things that have been done or may be done to aid the movement of traffic during blackouts or daytime emergencies.

The City of New York and the states in the surrounding area are joining hands in marking a secondary highway system so as to make other avenues available to civilians when the main routes are required for military or other important purposes. These routes are now defined by uniform signs, 16 in. square, carrying the word "Civil" and numbered from 500 upward so that they may be distinguished easily from the standard route markers. They indicate the less heavily used highways and city streets, which the civilian population will be able to use readily in moving from place to place or in case of evacuation of the metropolitan center. Other localities may mark evacuation and secondary routes by similar means.

In blackouts, traffic lights take on a new status. For trial blackouts, in which traffic is stopped, a prudent policy is to turn the lights off. However, if real blackouts occur, the operation of traffic lights in certain locations will be useful to handle incendiary bomb squads, fire apparatus, ambulances, emergency crews of various kinds, and employees changing shifts at defense plants. Experiments with masks for traffic lights, having slits in the shape of a Maltese cross, have not proved entirely satisfactory. Although visible at night, the masked light cannot be readily seen in the daytime, and might be the cause of more accidents than the non-use of traffic lights during short blackout periods.

PAVEMENT-MARKING EQUIPMENT IN OPERATION

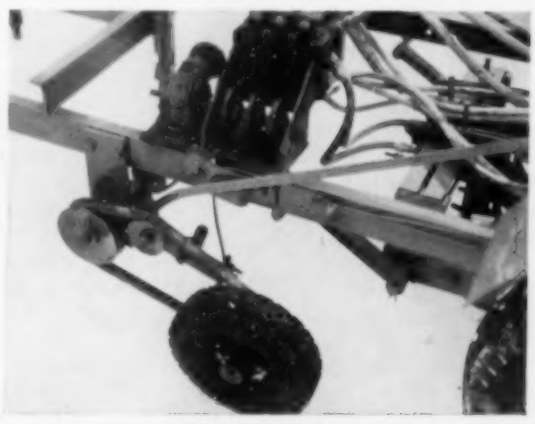
NUMBER OF METHODS AVAILABLE

According to the National Safety Council, an investigation of conditions on the West Coast after "Pearl Harbor" disclosed that during the blackouts the accident rate in some western cities jumped tremendously. In Los Angeles, for example, it increased 650% in one blackout. Most of these accidents occurred because traffic lights had been turned off, because motorists drove without lights, because they drove too fast, and because they did not have proper auxiliary equipment for the emergency. In San Diego, many accidents were caused by motorists straddling the center lane and sideswiping opposing cars. In most cities the authorized speeds were reduced to 15 or 20 miles an hour. In Seattle, traffic lights were dimmed by reducing the voltage so that the lamps could not be seen more than 60 ft.

In some sections of Canada automobile headlights have been masked during trial blackouts, except for a small amount of light showing through slits covered with blue cellophane or blue lacquer. This does not afford visibility to the driver, but makes his approach visible to opposing traffic.

The booklet *Blackouts* issued by the Office of Civilian Defense, shows that in England curbs, trees, poles, and other objects along the side of the road were painted white on curves and elsewhere to assist drivers at hazardous spots. This practice can be extended to guard rails, bridge abutments, and culvert headwalls. As our roads are relatively free of obstructions close to the pavement, we will probably find it necessary to install delineating markers.

Luminous paints or strips of cloth containing phosphorescent pigments may also be used. Fluorescent lacquers can be molded into letters for special markings at important streets and direction points. The use of hooded and dimmed lights and of ordinary white paint of course is more economical, and this is the plan, I understand, generally followed in England.



DETAIL OF PAVEMENT-MARKING APPARATUS WHICH PERMITS DUPLICATION OF DASHED LINES
Reduction Gear, Cam and Valve Arrangement Shown

SILK-SCREEN PROCESS OF MAKING SIGNS WITH STENCIL RAISED TO SHOW COMPLETED WORK

Other methods have been suggested. One suggestion is that Army trucks could move caravan fashion during blackouts by the installation of an Argon bulb near the windshield. This activates fluorescent pigments in a round disk on the rear of the truck ahead. It is said that, with the aid of black lights, U.S. Army trucks could be convoyed at night without the use of regular headlights, which might betray their presence to enemy planes reconnoitering overhead.

In certain localities it may be advisable, as a protection to defense areas, to camouflage roadways and insert other streets or highways in such a manner as to change the entire appearance of a district to aerial view. For example, it is claimed that roads may be erased from air view and other roads depicted by camouflage across the tops of industrial buildings, thus giving a large war plant the appearance of a residential area. In the last war the popular word was "camouflage"; in this war it is "blackout"—both connoting "to deceive."

Luminous materials fall into two classes of compounds—fluorescent and phosphorescent. Radio-active materials are not being considered because of the high cost and also because of the element of danger in their use. Fluorescent materials will glow in darkness during the time they are exposed to or activated by an ultra-violet lamp; they cease to give off light as soon as the energizing source is withdrawn. They have the advantage of being "on and off." They are useful for printing maps and may be combined with lacquers and paints for use in places not exposed to the weather.

MAP READING IN THE DARK

Most highway engineers are engaged in defense work of various kinds, principally against sabotage, in the repair of highways, and in the removal of debris. We may find it necessary to have maps that can be read in the dark. Maps printed with fluorescent inks and energized with a black lamp will accomplish this purpose.

Phosphorescent materials glow in darkness following exposure to sunlight, strong artificial light, or ultra-violet light. They are more adaptable to ordinary use for the reason that they do not require activation by special lights, and they retain luminescence for hours after the source of light has been withdrawn.

Recently I had great difficulty in purchasing a portable black lamp from commercial sources. This indicates that black-light equipment for field use will not be available on a wide scale for a long time. On the other hand, phosphorescent sheets or strips are now available in quantities and may be used as flags, roadside markers, arm bands, or to outline passenger cars and trucks, or for any other purpose where it is desired to have a surface visible in the darkness.

I have discussed with several paint manufacturers the question of adding phosphorescent pigments to regular traffic paint. If this could be done, it would be possible for cars during darkness to follow easily the center line of a highway. I was informed that it is impractical to do this, because the addition of phosphorescent pigments to lead or titanium base materials results in loss of luminous qualities, and neither fluorescent nor phosphorescent materials weather well in damp places. I was advised, however, that it might be practical, in some specialized cases, to apply a coating containing phosphorescent material on top of the white line, covering this with a varnish as a waterproofing agent; or to use cloth strips containing phosphorescent pigments.

This is a new field. Many manufacturers and technicians are working on it and many allied problems. More definite information will no doubt be available within a reasonably short time.

DEPENDENCE ON ENGINEERS

As a result of his observations in England, Walter D. Binger, M. Am. Soc. C.E., stated that we are only on the threshold of our knowledge of blackouts and civilian defense, and except for the organization of civilians for their own protection and for first aid to the injured, all parts of the work are straight engineering technology. Still it apparently took England some time to realize that they needed engineers to get results which could not be achieved by officials who were laymen.

As highway engineers, our part in civilian defense will be largely to maintain the means of transportation. This may or may not develop into a major task in some sections of the country, depending upon circumstances that cannot be foreseen. It is advisable, however, that we work, study, and plan, so as to be prepared for whatever may come.

As I see the picture with regard to signs and markings, we need to give more thought to the protection of present signs along our highways. We should spot paint signs to prevent the spread of rust where enamel is knocked off, and should keep them in good condition by repainting as often as necessary. We should consider the necessity of lane marking on a greater mileage of roads. We should paint objects along the roadside to assist drivers during blackouts, and we should give more thought to luminous paint and invisible lights for traffic signals and special markings. Especially should we direct our attention more than ever before to all those provisions that make for traffic control and highway safety during the strenuous times ahead.

ROUTE MARKERS BEING EMBOSSED WITH A HAND ROLLER

Water and Community Growth in Utah

Distribution of Population Is Determined by Location and Amount of Water Supplies

By RALF R. WOOLLEY, M. AM. SOC. C.E.

SENIOR HYDRAULIC ENGINEER, U.S. GEOLOGICAL SURVEY, SALT LAKE CITY, UTAH

UTAH is in that part of the West where water is limited in quantity and poorly distributed. Therefore population growth and movement in the state have been controlled directly by the discovery and development of new water sources. Hydrology has played an important part in the growth of agriculture and in community enterprise as well. Mr. Woolley compares Utah to the Biblical land of Palestine, where an accurate estimate of the available water supply can be made from a population count. This paper was first presented at a 1942 meeting of the Utah Section.

IN 1847 the Mormon pioneers made a notable trek westward across the Great Plains to find a suitable place to make new homes for themselves. They emerged from Emigration Canyon into the Great Salt Lake Valley, where mountain streams from the Wasatch Range watered scattered areas of grassy meadows and shady groves. Upon seeing the valley, their leader, Brigham Young, impressed by its beauty, directed settlement upon the site.

From this first white man's settlement in the state, the present Salt Lake City, small colonizing bands were sent northward and southward to establish new communities. Thus within three decades of the arrival of the first pioneers, nearly all of the more important present-day cities and towns of Utah were thriving communities. These were located only where water was available; growth stopped where the limits of the water supplies were reached. The prime necessity of water to community existence is obvious to those who must do the planning for community development, although it is often taken for granted by the masses.

Each of the early settlements of the state had its beginning along the banks of a small stream, usually on the fertile alluvial fan built by the stream upon leaving its canyon. Water for all purposes was diverted from the stream into small ditches which served as a distribution system. Gardens and fields were irrigated, livestock was watered, and culinary needs were supplied—all from the same ditch. The system was simple, and there was no concern about refinements because the germ theory of pollution in water was virtually unknown. Furthermore, during the early years of settlement, plans for home conveniences were secondary to the problem of self-preservation and protection against hostile Indians.

ABOVE: SALT LAKE CITY IN 1869—MORMON TABERNACLE IN CENTER; BELOW: SALT LAKE CITY IN 1942—ROOF OF MORMON TABERNACLE SHOWN BY ARROW

Salt Lake City had its beginning along the banks of City Creek. Its location was somewhat more favorable than that of other settlements because a number of streams issued from the Wasatch Range within a distance of a few miles, and all of them were available with a minimum length of ditches and conduits for use as the settlement grew. From City Creek the city grew southward along the foothills of the Wasatch Range, and one by one the waters of Emigration, Parleys, Mill, and the two Cottonwood creeks were used. These streams are still the principal sources of the city's water supply, but they have been supplemented by ground water for emergency needs.

GROWTH OF CITY CREATES WATER SUPPLY PROBLEM

The city of 150,000 people now has more than 390 miles of water mains under its streets and more than $13,000,000 invested in water works. The development of war industries and the resulting population increase have created a serious problem of water supply and distribution. But for the fact that the city has acquired a right to water from the Deer Creek Reservoir, the problem of water supply would be much more serious than it is, and quite probably would have forced the present industrial development and population increase to go elsewhere. Water from the Deer Creek Reservoir, in the Provo River project, will be brought into the city through a 40-mile conduit to be completed as quickly as priorities will permit the release of the necessary materials.

In the majority of cases, community and city water works have expanded under the pressure of increased demand rather than because of anticipated future needs. Extension of systems without benefit of proper planning has multiplied distribution problems. The history of Salt Lake City furnishes an example. It was 23 years after the first settlement that the Committee on Improvements began its survey of ways and means of bringing water in pipes into the principal streets of the city. In August 1871, the City Council authorized the employment of an engineer to run lines for water pipes and to prepare orders for the necessary pipe. That same year work was started on the water system. The water was provided primarily for fire protection and street sprinkling and was not supplied for domestic use until 11 years later. The fire department was originally in charge of the system.

During the decade ending in 1890, the city's population increased more than 115% and the sources of water supply then in use became inadequate. Tunnels were driven in the canyons of City and Emigration creeks in an unsuccessful effort to intercept underground flow. Artesian wells sunk along the Jordan River raised legal controversies and were finally plugged. Wells at Liberty Park produced about 3,000,000 gal a day, but were abandoned because the water was deemed unfit to mix with the canyon water. There has always been close agreement between supply and demand volumes. And in dry years it has been necessary to restrict the use of

water. Such restrictions tended to discourage new industrial enterprises seeking locations in Utah, as well as immigrants looking for homes.

GROUND-WATER SUPPLY TAPPED

Finally city officials sought cooperation with the U.S. Geological Survey in an investigation of ground-water resources to supplement the stream supply. As a result, 17 wells were drilled in the southeast part of the city and yielded 45.8 cu ft per sec of water. At this time (1934) the canyon streams were at an all-time low stage and a serious water shortage seemed imminent. Immediately following, plans were made for the city to participate in the benefits of stored water now being developed by the U.S. Bureau of Reclamation at the Deer Creek Reservoir. This move meets with increasing public favor because of the present industrial expansion. Work on Deer Creek Reservoir is being carried forward to meet these increasing requirements.

The water problems incident to the growth of Salt Lake City are not in any sense unique. Ogden, the state's second largest city, has had similar experiences. It too found temporary relief in the development of ground water, but such development brought about controversies, still unsettled, with water users along the Ogden River. The city acquired storage rights from the U.S. Bureau of Reclamation in Pine View Reservoir on Ogden River, and, like Salt Lake City, it cooperated with the U.S. Geological Survey in investigations of its ground-water supply. War industries are now increasing the requirements for water, and the city's water problems are consequently becoming more complex.

Urban communities of the state have not been alone in their water-supply troubles. The rural settlements have been facing increasing difficulties as they have grown and been obliged to spread the available supplies

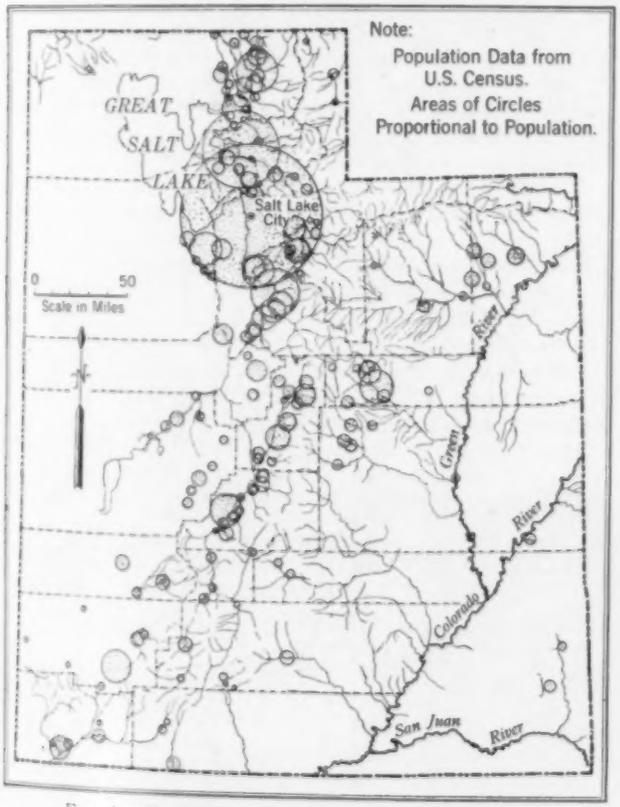


FIG. 1. DISTRIBUTION OF POPULATION IN UTAH
Areas of Circles Proportional to Population

ROCKVILLE, UTAH, EXEMPLIFIES THE SPREAD OF POPULATION THROUGH IRRIGATED VALLEY LANDS

over extended farm lands. No comprehensive analysis can be made without adequate records of stream flow and of underground waters. Need for such records became acute during the 10 years beginning in 1905 when 300,000 additional acres were irrigated and more than $11,500,000 was added to investments in such enterprises. The importance of the engineering projects concerned made extensive planning imperative. Stream-flow records were meager and the experience of the engineers had not prepared them for a careful analysis of the extent of available sources. Perplexing problems regarding water rights developed from the over-enthusiastic extension of irrigation projects.

The Jordan Valley in Utah is similar in many respects to the Jordan Valley of Palestine. When it is recalled that a devout band first settled Utah, it is not strange that the river connecting Utah Lake, a fresh-water lake, with Great Salt Lake, a brine lake, should be called the Jordan. Cities of Palestine, with their concentrated populations, exploited all local resources to assure their water supply. Where the streams and springs were small the villages were likewise small. The population was broken up into small communities with their farm lands nearby.

Conditions are similar in Utah, where the "farm village" is a community of people residing in a relatively compact area and cultivating farms adjacent to the village. The establishment of this type of village was quite natural under the conditions of early settlement, where there was need of protection from Indians. Often a wall surrounded the village, and water for domestic use was essential within this area. Irrigation systems were simple and limited to lands close at hand. The extension of canals and laterals, the development of reservoirs on the streams, the discovery of underground water supplies, the building of culinary water systems, and the development of wells, the telephone, the radio, the automobile, and improved roads have all contributed to the establishment of permanent farm homes. Population is spreading to new areas wherever water is available.

Although Utah's population at first was 100% rural, the 1940 census showed that more than three-fourths of the total population was living in incorporated places. At present 55½% of the total is found in communities of more than 2,500. The distribution and concentration of the population in all but a few of the smallest incorporated places is shown in Fig. 1.

AGRICULTURAL OPPORTUNITIES INSUFFICIENT FOR CONTINUED POPULATION GROWTH

The bulk of the state's population is contained within a strip 80 miles wide which runs north and south through the central part of the state. Climatic conditions, topography, soils, and water supplies make this zone the most habitable part. Virtually all of Utah's communities were established before 1900, and have in many instances reached a peak in population with a tendency to decline during the past decade. Since the limit of many water supplies has been reached, irrigation and agricultural expansion is no longer possible. There are insufficient economic opportunities to support a natural population increase.

MON TABERNACLE IN CENTER; BELOW: SALT LAKE CITY IN 1942—ROOF OF MORMON TABERNACLE SHOWN BY ARROW

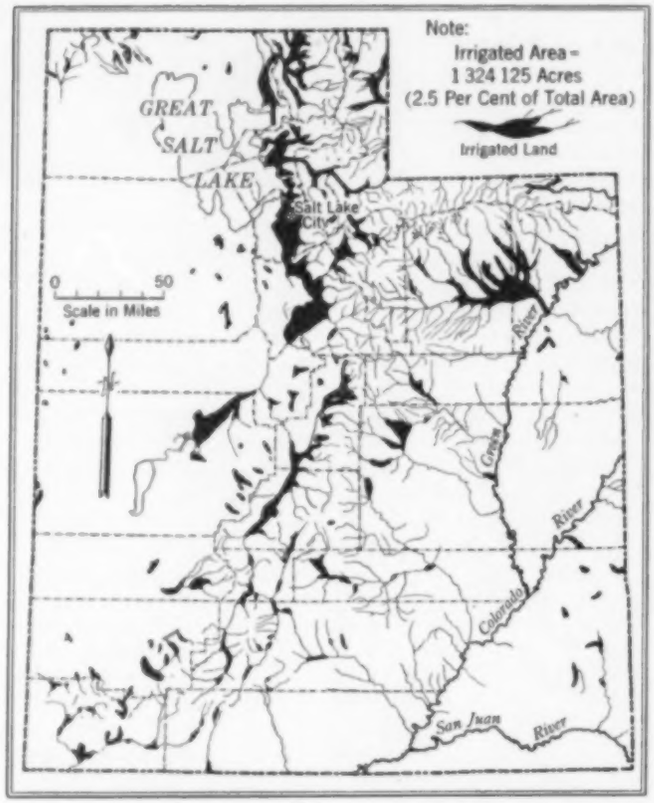


FIG. 2. DISTRIBUTION AND EXTENT OF UTAH'S IRRIGATED LAND Showing Marked Agreement with Population Growth

Because agriculture in Utah depends upon irrigation, and because the state's growth has depended upon agriculture, there is a notable parallelism between the population growth and the number of irrigated acres (Figs. 1 and 2). Water supplies are inadequate for all available arable lands, and crop failures due to water deficiencies on thousands of acres are not uncommon. Prior to 1900, irrigated areas increased relatively faster than population, but since then the reverse has been true. More effective irrigation technique has increased the productiveness of the existing acreage, but even with a most prosperous agricultural market, irrigation expansion is limited by the water supply. The 1860 census, taken 13 years after the first settlement, shows that there were 3.75 irrigated acres per capita. This ratio has decreased slightly since that time but so slightly as to indicate a fairly stabilized condition.

New industries in the Great Salt Lake Valley are stimulating population growth and increasing economic opportunity. Expanding markets for the farmer and the business man require increased water supplies and sewerage. New requirements for power, transportation, communication, housing, recreation, and all governmental services have created numerous engineering problems. It was not many years ago that planning for future capacity of public services was based upon a belief that population would grow at a fixed rate. Obviously, this would lead to fantastic figures.

A more logical procedure was presented in one of the most notable and fundamental of early research studies on this subject, that by Dr. Raymond Pearl (*Biology of Population Growth*, Alfred A. Knopf, New York, 1925). His first study of yeast cells showed that their growth under the most favorable conditions produced a logistic or S-curve (Fig. 3,*b*) when plotted against time. The native population of Algeria was then studied because of its relative freedom from the influence of migration. The same characteristic curve with a flatter slope was found (Fig. 3,*c*).

BEGINNING OF POPULATION GROWTH STUDIES

Soon after the publication of Doctor Pearl's work, studies were made by the writer of the population in Utah and its relation to industrial growth. Figure 3(*a*) shows the curve of population growth at that time. The solid portion of the curve is based on U.S. Census figures, and the dotted portion, beyond 1920, is the mathematical projection of the logistic formula of the curve. The balance between economic opportunity and population has been comparatively stable, and for this reason the census figures for 1930 and 1940 are remarkably close to the forecast.

It is increasingly apparent from studies of the past decade that population trends throw light on the social and industrial problems that lie ahead. It seems that in a society of unlimited economic opportunity, population will grow at a rather constant rate, but under conditions of limited opportunity the growth will be at a diminishing rate, approaching zero, or the level of fully utilized economic opportunity, sometimes called the saturation point.

In normal times good forecasting and engineering planning are the result of sober analytical judgment. In times of emergency, proper evaluation of many of the fundamental factors is impossible because of insufficient base data, and projects not economically feasible may often become indispensable.

Emergencies often change the economic pattern of a region by shifting industry, and some such changes may carry over into a stabilized new pattern. The realization of such possibilities for Utah depends on the water supply situation in local areas. It is therefore imperative that the state know its water resources. The problem is now more complex than it has ever been before. The most adequate program in the state's history for collecting and analyzing water supply facts has recently been initiated as a cooperative project between the state, through its State Engineer, and the U.S. Geological Survey. Much valuable information regarding Utah's water supply problems is expected from this program.

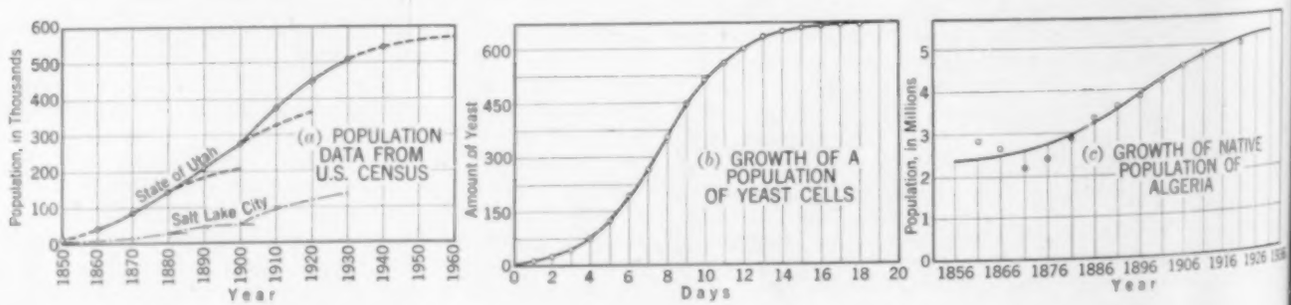


FIG. 3. COMPARISON OF POPULATION GROWTH CURVES

Transportation on the Home Front

Railroads Require Shippers' Cooperation to Boost Their High-Volume Service

By RALPH BUDD, HON. M. AM. SOC. C.E.

PRESIDENT, CHICAGO BURLINGTON & QUINCY RAILROAD, CHICAGO, ILL.

TO win the war, vast stores of equipment must be moved. Maine potatoes en route to Florida camps as well as Indiana steel to California bomber plants are the life blood of America's war effort. The response of the railroads to the challenge has been to increase the amount of freight handled by over 100%. Mr. Budd, in this paper originally presented at the Society's Minneapolis Convention, has collected facts and figures that show the rapidly increased service the railroads are rendering.

TO assist in winning the war is of course the main desire of transportation engineers today. The entire war economy of any country rests largely upon its means of transport. Ocean shipping is a matter of vital concern, but in volume it is exceeded by, and dependent upon, the transportation within the nation itself. Specifically, how adequate has that transportation been within the United States, and what are the prospects for the future?

For an intelligent consideration of the future performance of our carriers it is necessary to go back over the record of the past few years. Because the railroads handle most of the traffic, and also because railroad data are the most readily available, these records are drawn upon for the comparisons of traffic volume. Unlike many industries and individuals in this country, the railroads have now been engaged in the war effort for nearly three years. War in Europe, which was imminent in the summer of 1939, and actually began in September of that year, brought huge orders for certain materials and supplies.

As is always true when a major change occurs in industrial activity, the railroads immediately felt the effect. Before munitions or other war goods could be made, raw materials had first to be moved to smelters, mills, and factories, and before goods could be exported they had to be transported to the designated ports. The railroads as a whole realized the importance of preparing for traffic incident to a war in Europe which might spread throughout the world.

NEW AND REBUILT EQUIPMENT PROVIDED

Railroad officials well knew that there had existed a large and growing surplus of transportation facilities for several years, but it was difficult to say how much more expansion should be undertaken in view of the uncertainties as to the war's duration, and as to the United States' participation in it. A program of modernization which has now cost 10 billion dollars had been in process since 1923. New and rebuilt cars and locomotives of radically better types were provided, while tracks and signals, as well as shops and terminals, were greatly improved. The result, as of 1938, was a capacity per unit far beyond previous records. Under the circumstances, the equipment-building program since that time has been even more impressive. In the three years, 1939, 1940, and 1941, Class I roads installed the following new units: 170,575 freight cars, 660 passenger cars, and 45 electric, 387 steam, and 940 Diesel locomotives.

This does not mean that the railroad car and locomotive supply now is larger than it was in 1938 by the sum of these acquisitions. The retirement of many obsolete and uneconomical cars and locomotives has served to reduce the total amount of equipment substantially. But all the 171,235 cars and 1,372 locomotives which have been built during the last three years are of modern design and large capacity. They represent ability to handle freight and passengers far beyond the average car and locomotive. During the same three years (1939, 1940, and 1941) the number of highway trucks and automobiles was increased to a point substantially higher than at any previous time.

LOAD DISTRIBUTED TO FACILITIES

At the end of 1941 the national transportation plant consisted of approximately 233,000 road miles of railway, 1,685,000 railroad-owned and 275,000 privately owned freight cars, 38,000 passenger cars, 45,000 locomotives; 5 million highway trucks, 140,000 buses, and 29 million automobiles operating over 1,469,000 miles of improved highways; inland waterways, including the Great Lakes, which were handling nearly 20% of the total tonnage of the country; and pipe lines, which were moving 10% or more. Extensive urban and interurban electric systems furnished mass transportation for millions of people. Intercoastal and coastwise vessels provided low-cost transit for vast quantities of oil, coal, and lumber, whereas airplanes were increasing at a rapid rate even though they did not figure appreciably as carriers of freight.

These various forms of transportation took on the traffic load incident to war abroad and preparedness at home, as it came along, without any considerable strain simply by utilizing a larger proportion of their carrying capacity than had been needed during the preceding years. Thus for the first time they realized the bene-

SIX THOUSAND HORSEPOWER PULLS

FIG. 3. COMPARISON OF POPULATION GROWTH CURVES

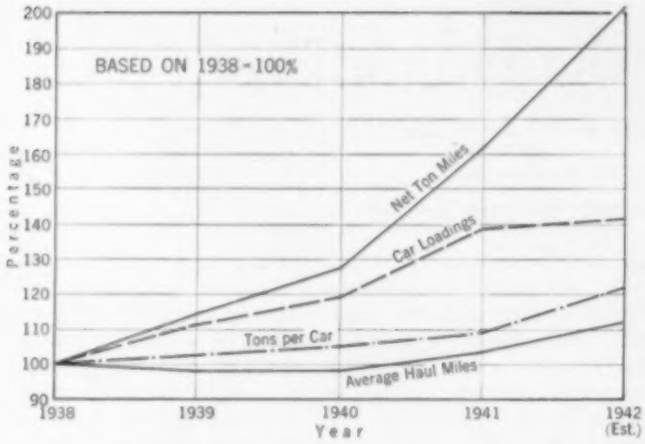


FIG. 1. TRANSPORTATION STATISTICS FOR U.S. RAILROADS SHOWING PHENOMENAL INCREASE IN TOTAL TRAFFIC HANDLED

fits from the extensive improvements that had been made. Reports for the first half of 1942 indicate that 48,769 new freight cars and 365 new locomotives were put into service in this period. That is a considerable amount. By moderately increasing the production during the last half of the year 1942, the railroad's capacity could be substantially enlarged over what it was at the close of 1941.

The common measure of railroad performance is the number of cars loaded, although a better indication is ton-miles, that is, tons moved one mile. To be conservative, car loadings are used here in reviewing the record since May 1939, the month which marked the beginning of the war influence. Taking car loadings for the year 1938 as 100, the figure for 1939 was 111; for 1940 it was 119; and for 1941 it was 139.

Loadings are currently about the same as they were at this time last year, but the trend of traffic has taken on a new characteristic. Prior to 1940 the peak of loadings was approached gradually from the summer level and culminated in October. Beginning with that year however, the load curve has flattened out, so that now it is relatively higher in the early months of the year and has a less pronounced peak in the fall. The result has been greatly to increase the yearly capacity of the carriers by utilizing more equipment in the off-peak season. In 1940 there was an increase of 2,446,356 carloads, or 7.2% over 1939, but surprisingly the peak week in 1939 was about 2% higher than that of 1940. The flattening out of the curve is due to the fact that war production continues quite uniformly throughout the whole year.

HEAVY GOODS MOVED

By their very nature, the defense program, and later the war effort, involved the so-called heavy or durable goods industries. During the 1930's business activity was largely in consumer goods, which favored the highway carriers rather than the railroads. With the revival of the heavy goods industries there was a sudden rise of unprecedented proportions in the kind of traffic peculiarly adaptable to railroad haul, that is, the mass movement of raw materials such as iron ore, coal, and lumber.

In like manner, prior to the time when selectee movements began, travel had been to a large extent by highway, but large service groups go chiefly by rail. With our entry into the war in December 1941, and the subsequent development of the rubber shortage, impetus was given to the transfer of traffic, both passenger and freight, from highways and ocean ships to the railways. Even so, the common carrier bus has taken on a tremendous load partly because of curtailment of the private automobile and partly because of heavy travel to training centers and war industries. Similarly, trucks have proved themselves essential war carriers.

The railroads, in addition to their primary service of transportation, have been called upon to assist in other ways. Considerable war production work is being handled in railroad shops. Then the large number of military training centers, new war production plants and plant enlargements, has necessitated building several thousand miles of tracks and supplying several hundred locomotives for switching service. Nearly all the equipment and rail for these purposes has been supplied by the railroads.

Second-hand rail comes from two sources, that released by relaying with new rail, and that obtained by tearing up tracks. Rails in this latter category come chiefly from abandoned branch lines. Since 1916 the total road mileage of railways has declined by about 21,000 miles. An additional 4,000 or 5,000 miles of lightly patronized branch lines could be abandoned with but little reduction in the amount of service rendered. Indeed we are informed by the Government such an amount of industrial trackage will be required during the last half of 1942. Moreover, considerable railway equipment which is handling almost no traffic on branch-line trains could be made available to the war effort.

STREAMLINING PROCESS ACCELERATED

An appeal to state authorities to permit reductions of service on lines which are but little patronized, has been made by Defense Transportation Director Joseph B. Eastman. Furthermore, in four or five cases to date, the Federal Government has requisitioned branch-line tracks. It would seem therefore that the streamlining process, which in peacetime was proceeding at about 1,600 miles of line abandonment per year, will be considerably accelerated as a contribution to the war effort.

Some quarters have voiced opposition to line abandonments, but the matter was well put recently by an Interstate Commerce Commissioner when he said: "It is not a case of the railroads abandoning the public; the public first abandoned the railroads." The war load has inevitably accentuated the concentration of most of the traffic upon a relatively small percentage of the railroad mileage.

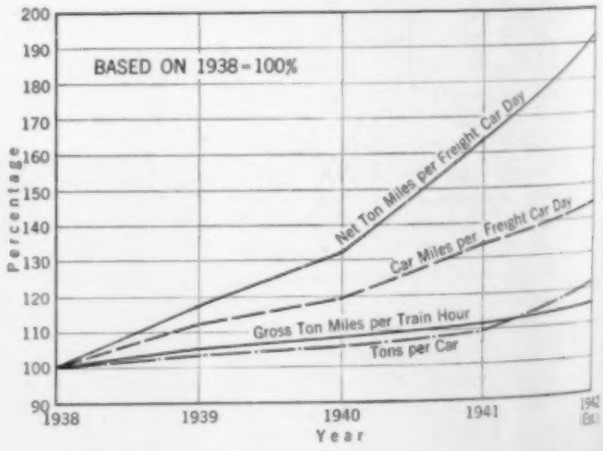
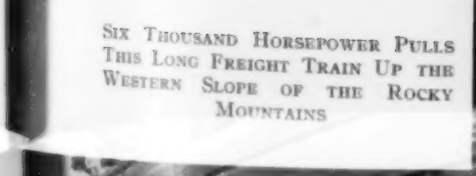


FIG. 2. TRANSPORTATION STATISTICS FOR U.S. RAILROADS, SHOWING GREATLY INCREASED EFFICIENCY IN HANDLING OF AVAILABLE EQUIPMENT



SIX THOUSAND HORSEPOWER PULLS THIS LONG FREIGHT TRAIN UP THE WESTERN SLOPE OF THE ROCKY MOUNTAINS

Photo by U.S. Army Signal Corps

MASS TROOP MOVEMENTS ARE CARRIED OUT MOST EXPEDITIOUSLY BY RAIL

TROOPS WAITING TO BE TRANSPORTED TO THE SCENE OF MANEUVERS

HEAVY GUNS AWAIT UNLOADING

Photo by U.S. Army Signal Corps

SUPPLIES BEING TRANSFERRED FROM RAILROAD TO TRUCKS FOR THE LAST STAGE OF THEIR JOURNEY

Railroads Do Their Part in the War Effort

A TRAINLOAD OF ARMORED TRUCKS READY FOR TRANSFER

AN ARMY TRACTOR-TRUCK STARTS ON ITS WAY BY RAIL

© *Acme Photo Service*

A SOLID TRAIN OF TANK CARS ON ITS WAY TO THE EASTERN SEABOARD

Assuming that the handling of transportation will be left with private management, the question of future adequacy is largely one of how much material and supplies the carriers will be permitted to have in order to keep their physical properties in first-class condition, to replace units worn out or destroyed by accident, and to provide for a reasonable additional capacity to handle the growing volume of business. The railroads' ability to handle the current volume of traffic is proved by what is being accomplished, but the unforeseen shortage of rubber and of intercoastal and coastwise boats, especially those used for the movement of oil and coal, has thrown extraordinary traffic upon the rails.

The longer haul of freight incident to the war effort has also increased the size of the job to be done. The year 1942 will set an all-time high average haul of about 400 miles from origin to destination, for all freight moved by rail. This compares with 250 miles in 1910, 305 in 1920, 315 in 1930, 350 in 1940, and 370 in 1941. The average load per car likewise has increased from 34.5 tons in 1920, 35.7 in 1930, 37.7 in 1940, and 38.2 in 1941, to an estimated 39.0 tons in 1942. These factors, plus the increase in cars loaded, have brought net ton miles to a point far above that of any previous time in our history, 1942 being estimated at more than double 1938, and 30% above the boom year 1929. Heavier loading, more gross ton miles per train hour, and greater mileage per car per day have produced a spectacular rise in net ton miles per car day in 1942, to nearly double that of 1938. Some of these data are shown in the accompanying Figs. 1 and 2.

PASSENGER TRAFFIC REACHES NEW LEVELS

While ton miles of freight have set these new high records, passenger miles have also been rising so rapidly that they are approaching the maximum of the top year, 1920. Four and a half million troops, not including those traveling on furlough, were moved by rail within the United States in the first five months of this year. When the equally heavy bus travel is taken into account, it is evident that common-carrier passenger traffic is at an unprecedentedly high level.

Obviously the very severe use of our transportation facilities necessitates heavier than normal maintenance and repairs. New cars and locomotives and rails are required in quantities above the average. In this connection Director Eastman has sounded several warnings, among which was an address delivered in Philadelphia on April 9, 1942: "So long as the machinery of transportation is clicking smoothly, it is easy to overlook the vital part which it plays in the war effort. Once, however, it begins to skip and falter at any point, as it did not long ago at this very port of Philadelphia, we hear about it from every war quarter. The new locomotives and cars which the War Production Board is proposing for the remainder of this year fall far short of what I have believed to be necessary for the successful prosecution of the war effort."

On June 23, Brig. Gen. C. P. Gross, chief of the Transportation Division of the War Department, testified before a House committee that the railroads "cannot go on forever without any additions or replacements. . . . I think there should be some support to Mr. Eastman's contention that they need some additional facilities for the work they will have to do." Clearly one prerequisite to adequate transportation for the future is sufficient material for repair, replacement, and new units, including track rail.

Another prerequisite is to leave the handling of our tremendous war traffic to those who have the necessary experience and have proved capable of doing the job. Many railroad officers and shippers learned in World War I, and know now, that the only way to avoid another transportation crisis is to make sure that cars are not again kept idle as warehouses but are kept moving as essential units of transportation.

COOPERATION ESSENTIAL

Since 1923 joint organizations known as the Shippers Regional Advisory Boards have dealt with the subject of car handling in a practical and methodical way. They were prepared to function and they have functioned superbly. It should be said also that Government authorities having to do with the movement of war supplies have realized the importance of not holding cars under load, and have given the fullest cooperation.

Our transportation plant, the greatest in the world, has carried its load and carried it well. It must continue to do so, for never before has victory been so dependent upon transportation. It is a part of, and cannot properly be considered apart from, the war effort. Every transportation man, every shipper, and every receiver seems determined to keep our plant going whatever the circumstances may be. Let us give them the material they need. Let us continue to give them the confidence they deserve.

LEAVING THE MESABI RANGE, 181 CARS CARRY 14,000 TONS OF IRON ORE

The Society's Contribution to the War Effort

Address Before Luncheon for Local Section Delegates at Minneapolis, Tuesday, July 21, 1942

By E. B. BLACK, PRESIDENT, AM. SOC. C.E.
CONSULTING ENGINEER, KANSAS CITY, MO.

WHAT has the American Society of Civil Engineers accomplished in serving the national effort? That is a fair question which any organization may well ask itself in these trying days. Fortunately it is one that need not embarrass us.

The Society has taken an active part in aiding the United States in its preparation for war. In June of 1940, the Society sent out questionnaires to engineering firms and individual consultants in all branches of engineering, to determine what services such engineers were ready to furnish the U.S. Government in national defense work. About 3,250 replies were received and analyzed, and copies were placed in the hands of the Quartermaster Corps, the Corps of Engineers of the Army, and the Civil Engineering Corps of the Navy.

Designated members of the Society have served in advisory capacities to various Government boards and committees engaged on special problems connected with preparation for war. Five official representatives of the Society were named to the Engineers' Defense Board, formed to advise the Office of Production Management with respect to eliminating waste, simplifying specifications and standards, improving design techniques where strategic metals were used, and selecting substitutes for scarce or unobtainable materials.

More than two years ago Past-President Hogan was made chairman of the Construction Advisory Committee to the Army and Navy Munitions Board (five of the six members of that Board were members of the Society), and throughout his tenure of office he called the attention of the Board to war problems on the horizon—all of which have developed. Past-President Fowler, while President of the Society, was drafted by the War Department to fill an important advisory position, which he still holds.

MEETINGS FEATURE WAR WORK

Since war was declared, all Technical Divisions of the Society have directed their efforts to the study of questions contributory to the war effort and civilian defense, the preparation of papers on such subjects, and their presentation at technical sessions at the regular meetings of the Society. For example, the program of the Spring Meeting at Roanoke, Va., was related only to war subjects. Many of the excellent papers have been and are being distributed through Society publications. Starting with the various meetings of committees of the Board of Direction on Sunday morning (July 19, 1942), and until the conclusion of the last session Thursday afternoon, the program of this Seventy-Second Annual Convention of the Society held at Minneapolis deals with war problems, or professional problems directly related to war activities.

Likewise, the Society's full-time staff has been giving war service. In part this has been in connection with Society work and in part after transfer to the armed services. H. F. Peckworth, M. Am. Soc. C.E.—who was invited to serve as editor of CIVIL ENGINEERING when D. P. Barnes, Assoc. M. Am. Soc. C.E., was called into the service as major in the Corps of Engineers—is now devoting his whole time to employer-employee problems, all brought about by war activities. Other important adjustments have also been required in the Headquarters personnel. Assistant Secretary C. E. Beam, M. Am. Soc. C.E., for more than a year has been serving in the Civil Engineer Corps of the Navy; Walter E. Jessup, M. Am. Soc. C.E., took Commander Beam's place, and early in July 1942 he was called to serve as a major of Engineers. Allen P. Richmond, Jr., M. Am. Soc. C.E., formerly Assistant to the Secretary, is now a lieutenant colonel, Field Artillery. Hal H. Hale, M. Am. Soc. C.E., a newcomer to the executive office, has been located in Washington since the fall of 1941 for the specific purpose of making the services of the Society available and understandable to the Army and Navy and to keep the Society in touch with engineering problems at the Capitol.

SERVICE IN TWO WARS

Perhaps the saving feature of the situation is that many of the present members of the Board of Direction have their military careers behind them. For the present at least they will be free to carry on Society work to the extent that it does not interfere with their war work as civilians—work in which all of them are engaged either directly in the field or through the regular routine of school, news, or other engineering activities. Colonel W. N. Carey is the only member of the Board now in uniform, but the war is yet young. In World War I—the war we fought to end war—42 of our members who served on our Board of Direction saw active service. For the Society as a whole, 1,557 members served in the Army, 108 in the Navy, and 71 in the Allied Armies; and 27 died in service—a total of 1,763, or every fifth member of the 8,590 in the Society as of the end of 1917.

Conditions in World War I were entirely different from those of today. All engineers are now in demand either in planning, producing supplies and equipment, or on the line. Our membership is more than double that of the last war, but our percentage of engineers in war activities and in the service is probably doubled or trebled.

On May 1, to relieve financial strain on members in the armed services, all those residing in the possessions of the United States, such as the Philippines, Guam, Wake Island, and others (about 40 members) were transferred to the inactive list for the duration of the war. Dues for 1941 and 1942 have been canceled and publications are being withheld. On May 1 the same provisions were made for about 160 members residing in enemy or conquered countries, also in China and Russia, or where exportation of exchange is forbidden. The Society is also allowing credit on exchange, and will accept from about 175 subjects of Central and South American countries 1942 dues billed so as to share equally with them the unfavorable rate of exchange.

Dues for 1941 and 1942 from about 360 subjects of the British Empire are to be accepted as follows:

COUNTRY	LOCAL RATE	U.S. VALUE
England	4£ 2 shillings	$16.55
Union of South Africa	4£ 2 shillings	16.55
Australia	4£ 2 shillings	13.24
New Zealand	4£ 2 shillings	13.25
Canada	20 Canadian dollars	17.36

On application, those in the Army and Navy, up to and including the equivalent grade of captain in the Army, may be exempted from payment of 1942 dues.

ALL SHARE RESPONSIBILITY

As engineers, we have a very definite part in the victory program. On January 27, Maj. Gen. Eugene Reybold, M. Am. Soc. C.E., Chief of Engineers, talked to the District of Columbia Section of the Society and declared that this is an "Engineer's War," and that for a long time to come

> "There will be no 'engineering as usual' in this country;"

that

> "The demands of the war effort have taken, and must continue to take, precedence over everything else,"

and that

> "All our resources must be brought to bear against the powerful combination of enemies arrayed against us. There is no royal road to the total victory which must be ours."

General Reybold expressed similar ideas in his talk at the Society's Spring Meeting in Roanoke, as reported in the June issue of CIVIL ENGINEERING. I doubt if all of us realize the fact that in this "Engineer's War" you and I each have a part in some necessary activity for our country—either in work behind the lines, in the preparation of facilities, materials or equipment for the combat forces, or as members of those forces.

CONSIDERING THE FUTURE

The Society is proceeding on the theory that preparation for, fighting, and winning the war are the things to be done first. But we have other problems as engineers. On the assumption that we must win the war there is a certain amount of planning we must do in order to meet post-war conditions. We know now what some of those post-war problems will be, but we will not know the nature or the extent of many of them until the reconstruction period comes at the conclusion of action on the fields of battle. It is certain that our post-war problems will be different if the war is finished in 1943 instead of in 1942, or in 1944 instead of in 1943. What we need is speed in all of today's engineering activities—and we cannot have action until we know where we are going. It is the Society's purpose to point out that course to you.

The engineering profession certainly is coming to a complete acceptance of the fact that there can be no doubt but that the future of our country and of the United Nations depends to a very great extent on the engineer. You and I know that many of us may not be here at the conclusion of this war against civilization. This country tomorrow depends on the youth of today, just as the future of engineering depends on the development of our engineering students and the young engineers of today. As citizens and engineers we must plan what we are going to do—not in 1943, 1944, or later—but now. The effort to get results is on. What are you and I going to do about it?

SPECIAL PROBLEMS WE FACE

There are two matters which I think are of vital importance in increasing the production of war materials and the facilities necessary to the training of our men for service in the Army and Navy. First, if it is necessary to increase our engineering personnel in order to plan and prepare for war and to fight, instead of conducting "business as usual," we should bring pressure to bear on public and private business that can dispense with engineering services for the time being. Our engineering schools are training students for war. Why cannot we dedicate all our organized engineering effort to the same cause—preparation for war?

The second situation which is of vital importance has to do with the lack of support for the boys being trained and sent to the front in the defense of our country and the Allied Nations. Those of us who for the past three or four years have been living with this problem, should do all within our power to bring it to the attention of Americans who have not had the same opportunity to understand how vital it is. I am speaking of labor—not skilled or common labor, but all labor, including the white collar classes, which we find in large quantities on every defense project whether it be construction or manufacturing.

I have no quarrel with the wages paid to "labor," but it is my belief that you and I have allowed, and are allowing, a very limited number of leaders in this country to dominate and direct labor in much the same fashion that Mr. Hitler has dominated and directed Germany. I believe that in order to increase production, whether it be munitions or construction, it is necessary for us to bring to the American citizen a very definite picture of the situation as it now is, so that all fathers and mothers will be able to see that the boys we are training and sending to the front are not getting a fair deal so far as support by this country, by you and by me, is concerned.

LIKE PRIVILEGES FOR SOLDIERS AND CIVILIANS

Perhaps what I am trying to say will be more easily understood if I put it this way: Our soldiers and sailors in training or at the front are entitled to the same sort of "fair treatment" that our men at home are now receiving, not with respect to wages perhaps, but certainly with respect to effort. We cannot take away from the soldier and sailor the possibility that he will lay down his life for his country, but we certainly can see to it that those of us far from the front lines are contributing something in the way of effort to produce those things necessary for the training, the equipping, and the support of our fighting forces.

It would be fair to all of us at home if we were to put our fighting forces on the same basis that you and I operate on, the basis on which we put American labor. That would mean a 40-hour fighting week, no fighting on Saturdays, Sundays, or holidays; sit-down strikes whenever necessary to impress the commanding officer that the food, the weather, or anything else is not exactly to our liking; at least time and a half for overtime; and last but not least, the right to select all our commanding officers up to and including the rank of captain. Soldiers and sailors would then be on the same fair basis so far as effort is concerned, with white collared, skilled, and common labor as it is used in the construction of projects necessary for the training of these soldiers and sailors. Their efforts would then compare with the operation of plants to supply materials and equipment to protect us as we try to conduct "business as usual," and howl about requirements which change our customary program of life.

The Society has under way, and will continue, a study of the problems of present and post-war conditions. I know that each of you has or will accept his responsibility outside of his usual normal activities, to do his part in helping to determine the route the nations of the world must follow in order to return all peoples to the lasting peace we must eventually secure when this war against civilization ends—a peace to control war.

Military Topographic Mapping

Principles Developed for Determining Selection of Map Standards

By Herbert B. Loper

Colonel, Corps of Engineers, U.S. Army; Chief, Intelligence Branch, Troops Division, Washington, D.C.

PLANNING and execution of military missions are the actual purpose of military maps. In the chain of command and execution, information is required pertaining to communications, supply and service installations, centers of population, obstacles, cover, geographical positions, drainage, and ground forms. Variation in the accuracy of this information required for different unit operations and in the form best suited to these uses calls for careful selection of style, size, and especially scale. Available maps do not in all cases supply sufficiently accurate information. Therefore the Corps of Engineers has undertaken a program of systematic revision and duplication. This paper was originally presented by Colonel Loper before the Surveying and Mapping Division at the Roanoke Meeting of the Society.

DEVELOPMENT of map styles, content, and scales in the United States has been governed principally by civil requirements, with the result that there are very few maps of medium or large scale designed for military use. Despite the fact that nations of Europe have emphasized military requirements to a greater degree, their maps cannot be said to approach the ideal in content or format much more closely than our own. Their principal advantage lies in the greater variety of types from which the military may choose for particular purposes, and the more complete and uniform coverage available. One further advantage lies in the consistent use of the decimal system of even multiples in the selection of map scales, and the working of the cartography into regular geographical patterns. Their principal defects have resulted from inferior drafting and attempts to crowd too much detail into limited space.

In examining the cartographic work of the United States, it is particularly illuminating to note the wide variety of special-purpose maps, and the absence of any logical or common-sense sequence of map scales or geographical arrangement. While the content of the map is the first consideration, the scale cannot be overlooked, since these two features are mutually interdependent.

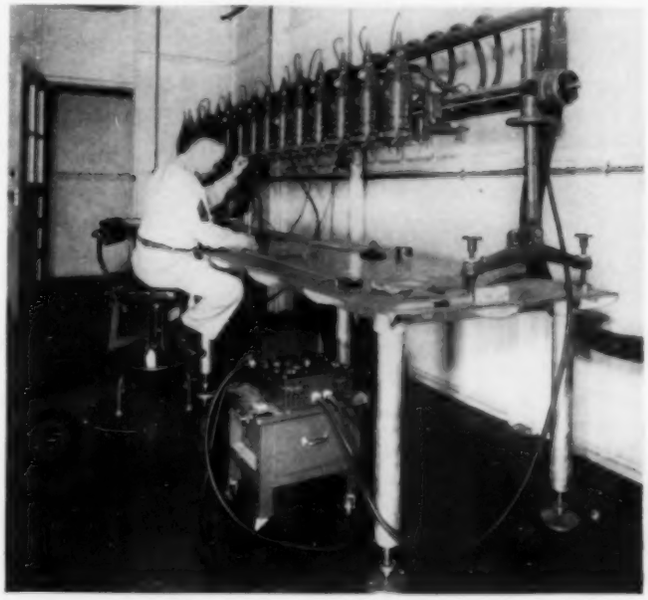
Present-day military cartography must meet demands for five special types of maps: (1) maps providing special military, geographical, and other important information (as for aerial and maritime navigation), (2) command maps for staffs of all kinds, (3) marching maps for foot and motorized forces, (4) maps for unobserved fire, and (5) maps for pioneer or construction work. The detail and accuracy with which this information must be shown varies between wide limits according to the requirements of the individual, group, or arm for which the information is prepared. Since successful combat results from coordinated action, no individual unit or arm can be said to be strictly independent as to its requirements for terrain intelligence. In the general case, therefore, information that is essential for one element of the combat forces is necessary to all other elements to a greater or less degree.

Omitting the special maps, which are not of general military application, and those for construction purposes, there are three classifications, which will be described.

Group 1. Maps for Command and Staff. (Fig. 1) Referred to frequently as strategic maps, these will depict the larger communication systems, regions of settlement, accessible and inaccessible terrain, flat country, primary and secondary mountain ranges, major water courses, and large bodies of water. In many areas of the world, of which portions of our southwest plains are typical, a few symbols on the map surface will tell the complete story. In other areas the density of road and railroad nets, cities, and other evidences of industrial development demand more space.

For the convenience of the user and for standardization of map sizes, it is usually desirable to accept uniform map scales for one purpose, regardless of the volume of information to be portrayed. The command map or operations map for large units will be constructed at scales 1/500,000 to 1/2,000,000. For the United States we have accepted the scale 1/500,000, which, except for the densely settled areas of the eastern region, is unnecessarily large. The German army normally utilizes the International Map of the World, scale 1/1,000,000, for this purpose, although for some areas it is admittedly severely overcrowded with detail and possesses other defects which render it far from ideal.

Editions required for troop use are not extensive, since distribution is to command and staff only. Consequently two elements of standard practice in military map production need not be unduly emphasized, namely, small sheet size to permit field reproduction, and severe simplicity of color combinations for rapid reproduction in single color. Certain liberties may be taken in the methods of cartographic expression as long as the face of the map remains sufficiently unobstructed to permit the addition of operational data. Layer tints express-



Typical Assembly of Multiplex Aero-Projectors

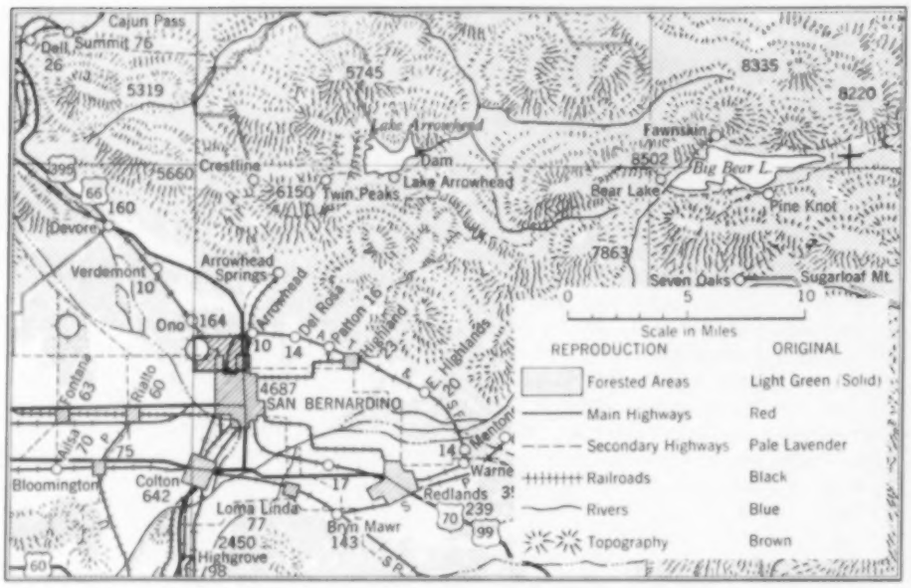


FIG. 1. COMMAND AND STAFF MAP, SCALE 1:500,000
Rectangle at Left Center Is Area Covered by Fig. 3

ing elevation, considered essential for aeronautical charts, are objectionable to ground forces, not only because they provide information which is not required, but also because they frequently obscure information of greater importance.

Group 2. Marching or Tactical Movement Map. (Fig. 2) This map will contain the same information as the command and staff map with the addition of data as to minor communication systems, minor obstacles, concealment, and observation. Since one of its major purposes is the computation of time-distance data, reproduction of transportation systems is of prime importance. The road systems should be depicted with sufficient accuracy to allow for an estimate of their use by individual conveyances, marching columns, two-way traffic, and large-scale transport operations. Obstacles, such as narrow streets through population centers, and inadequate vertical and horizontal clearances, deserve particular care. The existence of open country, cultivated areas, woodlands, and conditions of ascent and descent are important to the lateral operations of moving units.

Exact elevations or representations thereof are not important. Consequently the elevation information may be indicated by form lines or hachures, as long as the relative elevations of adjacent ranges are readily apparent. Finally, as an aid to orientation, names of geographical points, roads, and railroads must be shown.

Color combinations, if used for those editions prepared in base plants, must be suitable for reproduction in black and white for emergency supply. The format of the map is important not only because it must be carried on the person while on the march, but also to permit reproduction by mobile units in the field.

It has been suggested that motorized and foot troops cannot accommodate themselves to maps of the same type, because they have different units for the measurement of distance. This position appears to be untenable since there is no essential difference in the information requirements of motorized and foot units. The German army has depended largely upon the 1/100,000 map for foot troops, and the 1/300,000 map for motorized elements. The latter has not been found entirely satisfactory because of its inadequate depiction of towns. At this scale it is not possible to show narrow twisting streets and similar information which has an important bearing on the question of transit. The British rely upon the 1/100,000 map for this purpose.

The most complete and consistent coverage by topographic maps is provided by the U.S.G.S. Standard Atlas Map, scale 1/62,500. This map, which corresponds in general form to the tactical map of the Corps of Engineers, is of questionable value. It is not entirely satisfactory as a marching map, particularly for motorized units, partially because the scope of individual sheets is too restricted, but principally because its revision has not kept pace with the industrial growth of the country. On the other hand it fails to fall into the more precise map class (Group 3, which will be described) not entirely because of its small scale but because of the relatively inaccurate methods that are employed in its original construction.

The experience of the American Army in large-scale troop movements has been too limited to set up ultimate standards for map perfection. We are aware, however, that the essential elements of a troop-movement map, as previously set forth, can be depicted at a scale of 1/100,000 to 1/200,000 except possibly in metropolitan areas. The scale 1/125,000 has been selected as appropriate for the United States, the actual numerical denominator of the representative fraction being based

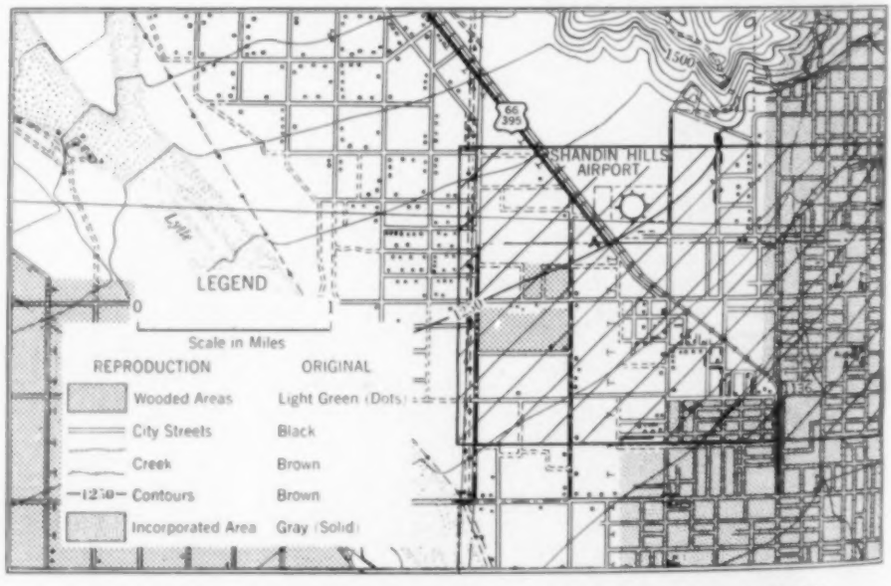


FIG. 2. MAP FOR MARCHING OR TACTICAL MOVEMENT, SCALE 1:62,500
Rectangle in Right Center Is Area Covered by Fig. 3

upon its direct relation to the existing tactical map rather than on any material advantage over slightly smaller or larger scales. By so doing, the reproduction equipment may be standardized for both the 1/62,500 and the 1/125,000 maps. Within the United States, therefore, effort for production of the troop-movement map is directed toward completion of coverage of vital areas at this selected scale.

Group 3. Maps for Unobserved Fire. (Fig. 3 The specifications for this map are dominated by position accuracy rather than by mass of information. The specifications now indicated for unobserved artillery fire fix a lower accuracy limit of 33 yd in horizontal position and 25 ft vertically. For many thorough analyses of the drafting and reproduction problems involved in map preparation, it is conceded that 0.02 in. represents the maximum random error in the plotting of detail features. From the drafting and reproduction standpoint, therefore, the minimum scale capable of meeting the horizontal accuracy requirements is 1/59,400 or 1/60,000. On this map, 50-ft roadways if reproduced to scale, would measure 0.01 in. across; isolated houses would appear as almost invisible dots, and a 20-ft stream would be difficult to show with the finest of drafting pens. If the actual scale is distorted by the introduction of map symbols, and this distortion is added to the maximum plotting error, the lowest order of precision to be expected is about 0.04 in. The minimum scale meeting the specifications for unobserved fire becomes then about 1/30,000.

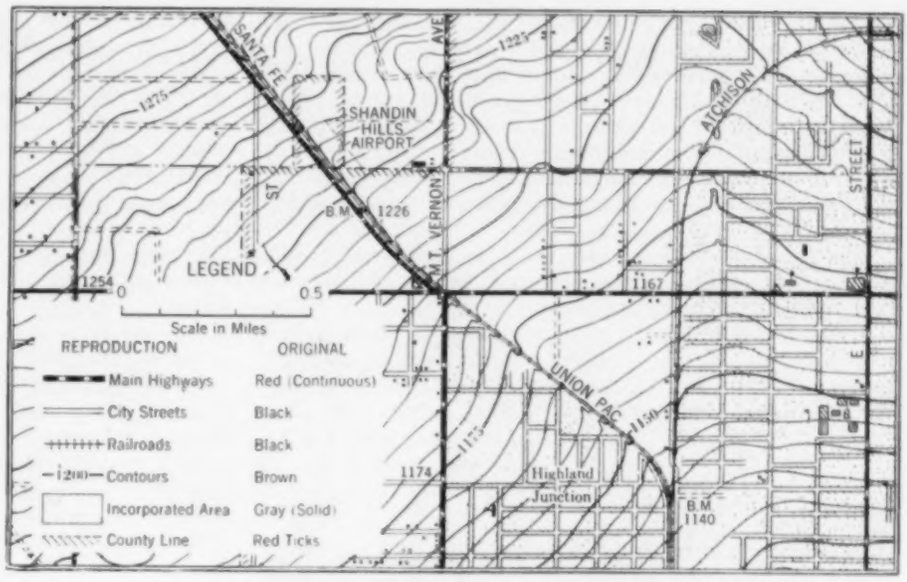


FIG. 3. MAP FOR UNOBSERVED FIRE, SCALE 1:31,680
Contour Interval Is 5 Ft

The general specification for vertical accuracy (25 ft ±) cannot be obtained universally, since the accuracy with which elevations may be shown by contours is a function of ground slope as well as scale. If the slope is 45°, a horizontal displacement in contour position of 25 ft is the maximum that can be accepted under the specification. Plotting with this horizontal accuracy demands a map scale not smaller than 1/15,000. When it is considered that in any method of surveying, with the exception of construction surveys, it is not possible to locate each contour by instrumental measurements at close intervals, it will be recognized that under the conditions stated, scales as large as 1/5,000 might be required to insure the demanded accuracy of vertical position. From the practical standpoint, it is customary to specify vertical accuracy as a variable with ground slope; or to require that a fixed percentage of plotted points shall lie within the specified accuracy range, thus allowing for unusual conditions or exceptionally steep slopes. From a similar approach to the problem both the British and the German military forces selected the scale 1/25,000 for the map for unobserved fire.

Our artillery has long preferred the 1/20,000 scale, a result no doubt of the stabilized warfare of 1917–1918 on the Western Front in France. This map was standard with the French army and naturally our troops become accustomed to its use. Artillery firing aids were adapted to that scale; consequently recommendations for changes to other scales have met with strong resistance. The trend of modern warfare, introducing the quick thrust of fast armored troops and the practice of encirclement, is accompanied by a change in artillery-fire control tactics, and a corresponding change in map requirements.

In warfare of position a single map sheet, carefully corrected in accordance with daily changes in hostile dispositions, serves the artillery requirements quite admirably. A single map sheet may cover the territory of immediate interest to a battery, battalion, or regiment for days or even weeks. This condition does not exist in a warfare of movement, either for the offensive or the defensive forces. In the interest of economy of effort in the preparation and distribution of maps, as well as to encompass the largest practical area for the convenience of the user, it is essential that the minimum scale necessary to meet actual requirements be used. When detailed large-scale maps are prepared in support of deliberate operations, therefore, the tendency will be toward scales of 1/25,000 and 1/50,000.

The expression, "map for unobserved fire" has been used throughout this discussion to designate the large-scale map designed primarily for that purpose. Obviously this map is not intended for the exclusive use of units engaged in that type of operation; nor is it to be assumed that all large-scale maps produced will fully meet the qualifications set up for this map. The conditions of accuracy and content will be governed by the precision of the aerial photography, the density of the ground control which can be established, and the time allowed for completion of a given area.

TYPES OF SPECIAL MAPS

Among the special maps needed in military operations are aeronautical charts. The preparation and supply of these is a function of the Air Forces. The Chief of Engineers, acting as a contractor for the Chief of the Air Forces, undertakes a great deal of the work involved in the preparation and reproduction of this special type of map. In many cases the smaller-scale aeronautical charts serve quite well as strategic maps and are produced and distributed by the Chief of Engineers for that purpose. The standard aeronautical charts are: planning charts of the world at a scale of 1/5,000,000; long-range navigation charts at a scale of 1/3,000,000 and 1/1,000,000; ground pilotage charts at a scale of 1/1,000,000 and 1/500,000; approach charts at a scale of 1/250,000; and target charts at a scale of 1/50,000 and smaller.

Planning and long-range navigation charts need no particular explanation. Ground pilotage charts are characterized by emphasis upon major natural and artificial features which serve as guides to the pilot, rather than upon extreme accuracy of position and completeness of detail. Approach charts are constructed for selected critical areas with a view to providing bombardment aviation with information sufficient to lead it to the general vicinity of selected targets. Target charts are large-scale plans of bombardment objectives from which the pilot and the bombardier may select the specific targets of their immediate missions.

Many maps produced and published by commercial agencies are regularly supplied to and used by military forces. Those maps of a general character as published by the National Geographic Society, American Geographical Society, and others, are extremely valuable for

MAP-REPRODUCING TRAIN OF THE ENGINEER BATTALION, TOPOGRAPHIC ARMY

the broad phases of strategic planning. The International Map of the World (scale 1/1,000,000) is used by the military forces of all countries, not only in its existing form, but also as a basis for the preparation of special small-scale maps for aerial navigation and many other purposes. The usual means of supply of maps produced by commercial agencies is through direct purchase. In cases where the demands for maps of this character are extremely large, it is customary to make special arrangements for their reproduction under supervision of the Chief of Engineers.

It is obvious that for many prospective or potential theaters of operations we are entirely dependent upon maps which have been prepared by other governments or by foreign military forces. In addition to a vast quantity of map information contained in the library of the Army Map Service, we have for our use maps of many areas contained in public and university libraries throughout the country. These data, supplemented by special reports of observers and descriptive materials of all sorts, form the basis of new compilation projects. The character of the detailed maps which can be prepared for any given theater of operation depends, therefore, upon information which has been published heretofore and upon the time available for translating it into usable map form.

In addition to operating a modern reproduction plant under its own roof, the Army Map Service handles much of its work through commercial contracts. Likewise, in the compilation and preparation of map data, use is made of the facilities of the map-making industry in the United States.

ORGANIZATION OF TOPOGRAPHIC TROOP UNITS

Topographic troops are organized in three echelons. The first of these is the Engineer Battalion (Topographic) (GHQ), whose normal function is the preparation of detailed, precise maps of important areas under a long-range mapping program. The organizations are equipped and trained for complete map preparation and supply, beginning with the establishment of ground control, and ending with the distribution of finished lithographed sheets. The principal instrument utilized is the multiplex projector, which is particularly adaptable to mass production methods. This instrument was chosen by the Corps of Engineers, after extensive investigations of photogrammetric methods, as the best solution to its problem of mapping with a minimum of ground control. The procedure whereby we may set up a visual ground model, spanning a wide area, is quite suitable for the extension of mapping into hostile territory which cannot be occupied by ground troops for the establishment of control. Frequently, the stereocomparagraph, or some other simple type of non-universal stereoscopic plotting instrument, is used with the multiplex projectors to expand the output of the topographic troop unit.

The second echelon of mapping troops is the Engineer Battalion (Topographic) (Army), which is designed to meet the immediate needs of the mobile forces in the field. This unit will devote its major effort to the hasty preparation of photomaps and planimetric maps in immediate support of ground operations and in the revision and reproduction of those maps which were in existence prior to the beginning of operations. It uses simple and rapid methods of map revision and compilation, utilizing aerial photographs when available. This unit is also capable of performing the entire mapping cycle from establishment of ground control to production of lithographed maps.

The lowest echelon of mapping troops is the Engineer Company (Topographic) (Corps), a small unit patterned after the Army Battalion and capable of performing the same type of work on a much smaller scale in direct support of the Army Corps to which it is assigned. A similar unit, the Engineer Company (Top) (Aviation) is designed especially to work with the Army Air Forces in the revision of aeronautical charts and the preparation of target charts.

TIMELINESS ESSENTIAL FOR MILITARY MAPS

Essential types and characteristics of military maps follow certain patterns, according to the needs of the individual group or arm by which they are to be used. The scale and area coverage are designed to correspond with the minimum quantity of information essential to the successful accomplishment of a military mission. The characteristics mentioned are the ideal. In practice something less than the ideal solution must satisfy. In a general way every map is more or less out of date by the time it is published. Even if it was accurate in the minutest detail at the time the information was assembled, changes in natural and artificial features quickly render it inaccurate by the time it is used.

The first requirement of a map for military use is not its accuracy of detail, its accuracy of position and orientation, or the neatness and precision of its cartographic expression. The one feature without which a map is useless is its timeliness. A map is an instrument of information only if it covers the area of actual and immediate interest and is in the hands of the individual who needs it when that need arises.

Consequently, while great stress is laid upon those characteristics of maps which render them most valuable for military use, the map-making services supporting the armed forces are continually and emphatically impressed with the doctrine of immediate service. When the necessity arises for map coverage to support an actual or impending operation, if need be those practices and procedures designed in the interest of precision, completeness, and clarity are discarded in the interest of speed.

Underflow Studies at Lake Issaqueena

Investigations by Sedimentation Division of Soil Conservation Service Yield Valuable Results

By J. W. JOHNSON, ASSOC. M. AM. SOC. C.E.

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FOR several years the Sedimentation Division of the Soil Conservation Service has been making investigations on reservoir silting, in an effort to find at least a partial cure for the high silting rate which afflicts many of our reservoirs. Because Mr. Johnson gives information on the frequency of occurrence of underflows, and on the amount of sediment that may be vented by their proper utilization, his paper will have considerable interest. The operation of sluice gates during flood periods has proved quite effective. The Lake Issaqueena Dam was chosen for a series of observations to determine the effective limits of this procedure in a specific case. Mr. Johnson points out the need for quick and convenient control of gates to draw off the turbid underflow.

BY way of introduction it may be well to make some general statements regarding the behavior of underflow in reservoirs. The coarse material will all be deposited as a delta at the head of a reservoir. The fine material, on the other hand, may not be deposited completely; some of it may pass through the reservoir, either by general mixing or by passing along the bottom as a dense current. It may be possible under some conditions, to pass an appreciable amount of fine material through a dam at relatively low cost by the operation of properly located outlet gates, but only in exceptional instances can anything be done economically to remove the delta deposits of coarse material.

The phenomenon of underflow in a reservoir usually occurs where the heavier, sediment-laden water of the inflowing stream flows under the lighter desilted waters already in storage. An underflow in a model reservoir in which the difference in specific gravity between the clear and the silty water was only 0.0035 is illustrated in Fig. 1. The higher density of the underflowing current may be due not only to suspended matter, but also to dissolved matter or temperature differences, or to any combination of these factors.

During a flood, the stored water in some reservoirs, where conditions favoring underflow are not present, may mix with the inflowing sediment-laden water and the whole become turbid. Eventually all material (except unflocculated colloids) slowly settles and the water clears, provided conditions are not altered by subsequent floods.

Venting of sediment-laden water from a reservoir can be controlled to a certain degree by the proper operation of gates located in the dam. In order to obtain information on this important problem, investigations extending over a period of several years have been made by the Sedimentation Division of the Soil Conservation Service. To apply the principles developed in laboratory studies to the development of methods for venting sediment from an actual reservoir, investigations were made at Lake Issaqueena, in northwestern South Carolina, by the staff of the Sedimentation Division. This reservoir was chosen because of its size and flow characteristics. Measurements made on streams in this Piedmont region of the Southeast have shown that their load consists very largely of fine material. The finely divided particles normally make a more important contribution to the deposits in reservoirs situated on these streams than do the coarser particles.

Lake Issaqueena, created in 1938, and intended for recreational purposes, had an original capacity of 1,836 acre-ft, a length of 7,400 ft, and a maximum depth at the dam of approximately 34 ft. The 14.02-sq mile drainage basin of the reservoir lies near the inner edge of the Piedmont upland and is characterized by rolling to hilly topography. At present 49.7% of the area is cultivated, 40.2% forested, and the rest composed of pasture, urban, and idle land. The area has been subject to moderate to severe field, road, and stream-bank erosion. There were indications that underflows of sediment-laden water occurred in this lake on certain occasions.

Of interest in connection with the problem of the passage of sediment through Lake Issaqueena is the mechanical composition and the distribution of the sediment deposits. As a result of a sedimentation survey made in April 1941, it was found that of the original capacity of 1,836 acre-ft, 1,748 acre-ft remained. Thus, a reduction of 88 acre-ft by sedimentation had taken place over a period of 2.9 years. The sediment is sharply divided into delta and bottom-set deposits. The deltas comprise 47.8% of the total reservoir accumulation, and the bottom-set deposits cover the remainder.

A thick deposit of sediment found immediately upstream from the dam no doubt is a result of sediment-laden underflows that move along the bottom of the lake, and drop their load when they become ponded near the dam.

The investigation was intended primarily to yield information on the frequency of occurrence of underflows

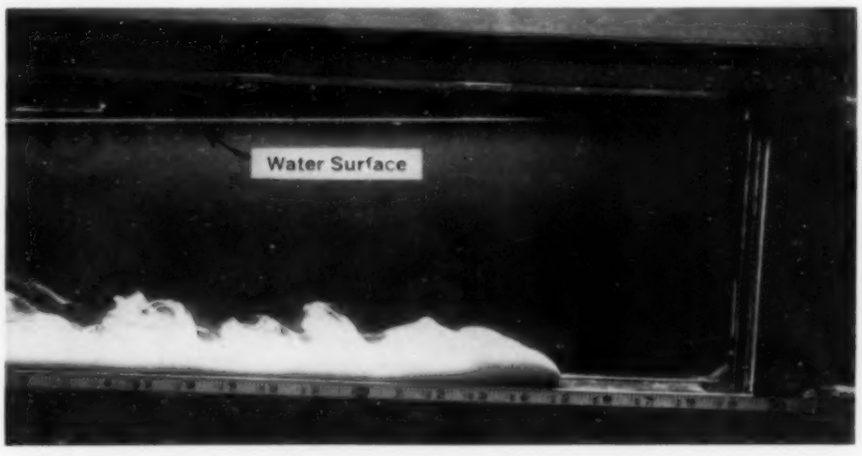

FIG. 1. UNDERFLOW IN MODEL RESERVOIR
At Soil Conservation Service Cooperative Laboratory, California Institute of Technology

FIG. 2. LAKE ISSAQUEENA DAM—SLUICE GATES APPEAR AT FURTHER END

in the lake, and the general magnitude of the volume of sediment that could be passed through the reservoir by the simple and inexpensive plan of sluice-gate operation.

FREQUENT SAMPLING DETERMINED UNDERFLOW

By permitting the normal outflow from the reservoir to pass through the sluice gates, located near the base of the dam (Fig. 2), the passage of an underflow through the reservoir could be detected by frequent sampling of the water discharged from the gates. If, shortly after a rise of stage occurred, this sampling showed a decided increase in the suspended-matter concentration, with little or no change in the concentration at the surface, then an underflow of sediment-laden water surely must have passed through the reservoir.

The gate that controlled the flow through the 24-in. pipe, located in the base of the dam, was adjusted to discharge the low-water outflow so that little or no water passed over the spillway except during floods. Dip samples of water for the determination of suspended-matter concentration were obtained in pint milk bottles at the lake surface and at the outlet from the sluice gate.

The vertical distribution of suspended-matter concentration and temperature in the lake was also measured. These measurements were based on individual samples collected at various depths. Normal sampling procedure was to lower an air-filled pint milk bottle, in a special holder, to the desired depth by means of a marked sounding line, and then to remove a $^1/_2$-in.-diameter plug in the rubber stopper of the bottle by pulling an auxiliary line. When filled, the bottle was pulled from the lake and the temperature of the sample immediately obtained with an ordinary laboratory thermometer.

Most of the verticals were taken from a platform on the upstream side of the dam, upon which the gate-lifting mechanisms are located. On several occasions verticals also were taken at various points throughout the length of the lake from a boat.

An automatic stage recorder was installed on Sixmile Creek, the main inflowing stream, approximately $^3/_8$ mile above the head of backwater. This recorder was installed primarily to give a record of the maximum stage. A stage recorder was also installed at the dam. Unfortunately, arrangements could not be made to sample inflowing streams with sufficient frequency during floods to permit an estimate to be made of the sediment load entering the reservoir. However, it is believed that the various vertical distributions of sediment concentration, as measured after a stream rise, if used in connection with a reservoir capacity curve, permit an accurate estimate to be made of the sediment in suspension in the lake. Precipitation records were obtained from a recording gage located at Clemson, S.C., approximately six miles from the dam.

On nine occasions between August 1940 and April 1942 the concentration of the water discharged from the sluice gate increased considerably without an appreciable change in the concentration of the surface waters. Immediately preceding these periods, a significant rainfall and a resulting rise in stage of the inflowing stream were observed. Unquestionably underflows of sediment-laden water passed through the reservoir. In all cases, however, the gate discharge was less than the discharge of the underflow, and a pool of turbid water formed in the lowest part of the reservoir. To withdraw as much of the sediment as possible before it settles to the bottom requires a high gate discharge. It is possible that if the discharge is too great, clearer water from above will also be drawn through the gate. However, if conservation of storage capacity is more important than the conservation of clear water, the discharge that will permit the greatest amount of sediment to be vented in the shortest time should be used.

Of interest are the conditions existing after the underflow that occurred in March 1941. The suspended-matter concentration of the surface waters started to increase, reached a peak concentration that was greater than that of the water being discharged from the sluice gate, and then receded. A possible explanation of this phenomenon is that an overflow of sediment-laden water occurred. This overflow probably was caused by water of relatively high temperature flowing over the cooler underlying lake waters and carrying with it any suspended matter resulting from general mixing at the head of the lake during the previous stream rise.

QUANTITY OF SEDIMENT VENTED

In August 1940 exceptionally heavy rains followed in the path of a hurricane that swept the South Atlantic states. Rainfalls of 3.44 in. on August 12 and 5.14 in. on August 13 were recorded by the Clemson gage, with the result that a near-record flood occurred. A maximum discharge of approximately 1,580 cu ft per sec passed over the spillway of the Lake Issaqueena dam. A vertical distribution of sediment concentration measured on August 21, a few days after the flood, indicated that because of the relatively large inflow either a general mixing between inflow water and lake water occurred and extended completely down the lake to the

dam, or a complete change of water in the lake had taken place. On October 31, more than two months later, a second vertical distribution of sediment concentration was measured and showed that the only water of high-sediment concentration remaining in the reservoir was a relatively thin layer approximately 2 ft thick along the bottom.

During the period between August 21 and October 31, the gate on the 24-in.-diameter sluice pipe was adjusted to discharge the low-water outflow from the reservoir so that little or no water passed over the spillway. Sediment distributed throughout the body of the reservoir by general mixing during the flood was greatly reduced in quantity during the intervening period by settlement and by discharging water containing high-sediment concentrations from the sluice gate. Thus, by computations using the vertical distribution of sediment concentration and the capacity curve of the reservoir, it was estimated that 975 tons of sediment were in suspension in the lake on August 21, but on October 31 only 120 tons remained. The difference, 855 tons, either settled or passed through the sluice gate.

It was estimated from the records of the gate discharge and concentration of these waters that 148 tons, or 17% of this sediment, had passed through the sluice gate. Although this amount was not large, it is of importance to note that a much larger quantity could have been vented had the discharge through the gates been controlled for this particular purpose. That is, instead of a discharge of only 6.5 cu ft per sec, discharges up to the maximum capacity of the gates (approximately 250 cu ft per sec) could have been used for short periods following floods to vent a large volume of water from the pool in a relatively short time.

FREQUENT SAMPLING DETERMINED SEDIMENT CONCENTRATION

In an attempt to obtain detailed information on the efficiency of venting the sediment transported through Lake Issaqueena by underflow, a program of sampling and gate operation was carried out during the period October 27 to November 3, 1941, when two underflows passed through the lake. A summary of the observations made during this period appears in Fig. 3. These observations include a record of the stage of the main inflowing stream, the lake level at the dam, suspended-matter concentration of the surface waters and of water discharged through the sluice gate. A few observations of suspended-matter concentration in the inflowing stream also were made. From a record of the sluice-gate setting, the discharge through the gate was obtained from a calibration curve.

To obtain information on the extent and sediment content of the pool of highly turbid water then existing in the lower part of the reservoir, several observations on the vertical distribution of suspended-matter concentration also were made at various points throughout the length of the lake. Those taken at the dam are shown in Fig. 4.

Following a rain of 0.55 in., as recorded on the Clemson gage on October 27, a rise in stage was observed on the main stream flowing into Lake Issaqueena. A few samples of the inflow were taken and showed a maximum sediment concentration of 590 ppm. This turbid water entered the head of the lake at 6.00 p.m. on that day. Samples of water taken on the following day failed to indicate that any underflow had reached the dam (Fig. 3). A sample taken on October 30 showed that the sediment concentration in the sluice-gate discharge had increased from 20 to 90 ppm while the surface concentration remained unchanged. From the vertical distribution of suspended-matter concentration measured on October 30 (Fig. 4*a*) it appears that the underflow was ponded in the lowest part of the reservoir to a depth of approximately 11 ft. From a consideration of the length of the lake and the time between samples, it appears that the underflow passed through the lake at a velocity of about 0.10 ft per sec, or possibly less.

During the night of October 31, rain amounting to 1.30 in. fell and another rise of stage was observed on Sixmile Creek. Samples of the inflow were obtained several hours after the maximum discharge (and no doubt the maximum suspended-matter concentration) had occurred. The maximum concentration found in these samples was 1,071 ppm.

On November 1 the maximum observed concentration of suspended-matter in the discharge through the sluice gate was 504 ppm. Vertical distribution of sediment concentration on this date is shown in Fig. 4 (*b*). A pool approximately 7 ft in depth then occupied the lower part of the reservoir. As shown in Fig. 3, the discharge through the sluice gate was increased from 5.8 to 13.0 cu ft per sec at 2:40 p.m. and then further increased to 28.4 cu ft per sec at 3:20 p.m. in an effort to draw out most of the water from this turbid pool. Apparently the flow into the pool exceeded even this increased outflow because a measurement made on the following day showed that the depth of the pool of turbid water had increased to approximately 11 ft (Fig. 4*c*). Observations taken at various points throughout the length of the lake on this date showed that the upper surface of the pool was

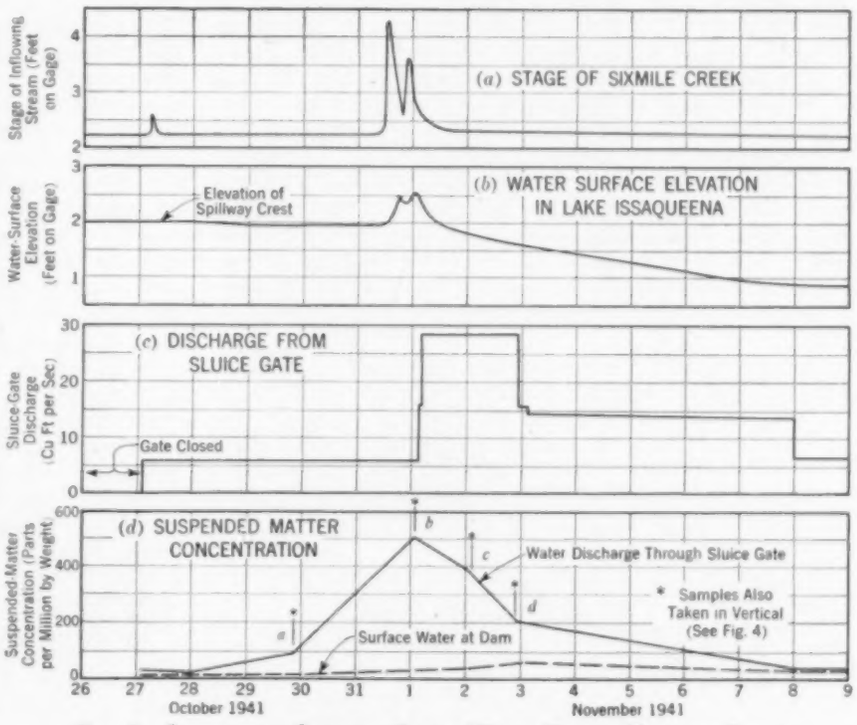
Stage of Inflowing Stream (Feet on Gage)
(a) STAGE OF SIXMILE CREEK
Water-Surface Elevation (Feet on Gage)
Elevation of Spillway Crest
(b) WATER SURFACE ELEVATION IN LAKE ISSAQUEENA
Sluice-Gate Discharge (Cu Ft per Sec)
(c) DISCHARGE FROM SLUICE GATE
Gate Closed
Suspended-Matter Concentration (Parts per Million by Weight)
(d) SUSPENDED MATTER CONCENTRATION
Water Discharge Through Sluice Gate
Surface Water at Dam
* Samples Also Taken in Vertical (See Fig. 4)
October 1941
November 1941

FIG. 3. INSTANCE OF SEDIMENT-LADEN WATER VENTED THROUGH LAKE ISSAQUEENA, OCTOBER-NOVEMBER 1941

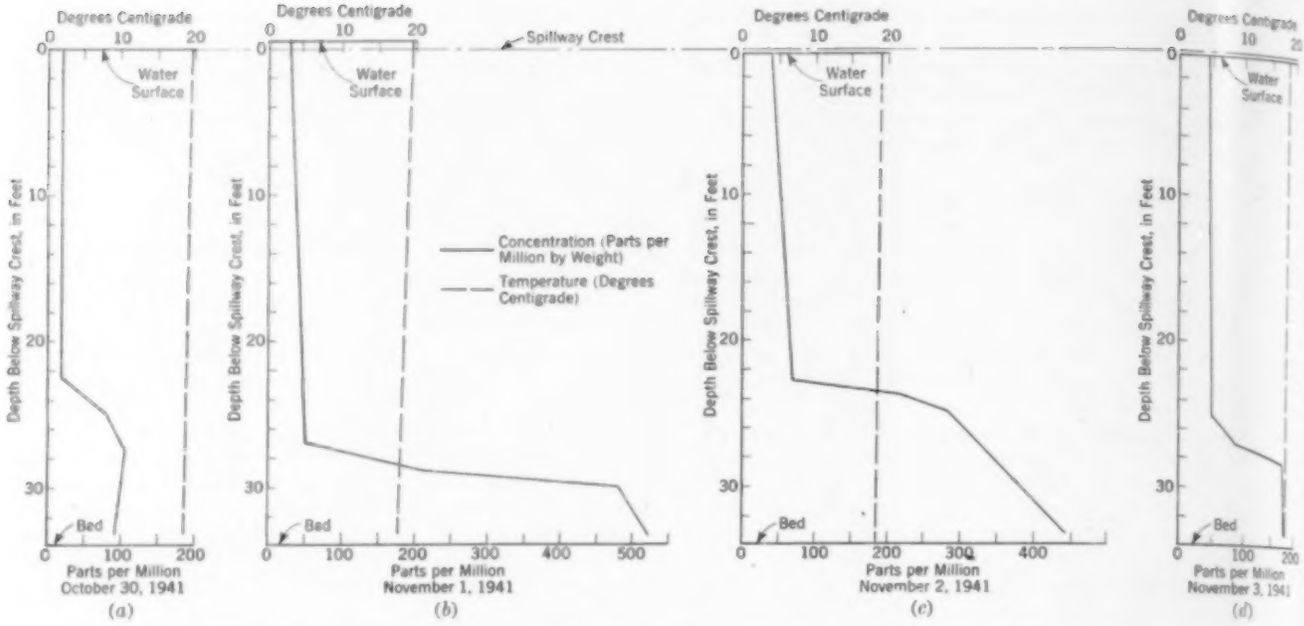

FIG. 4. VERTICAL DISTRIBUTION OF SUSPENDED-MATTER CONCENTRATION AND TEMPERATURE IN LAKE ISSAQUEENA

approximately level, indicating that a condition of equilibrium had been reached.

The discharge from the sluice gate was permitted to remain at 28.4 cu ft per sec, and on November 3 another vertical distribution of suspended matter was obtained (Fig. 4*d*). This showed that the depth of the pool had decreased to 9 ft, and that the maximum concentration had decreased to 175 ppm.

These various observations are of value in demonstrating the effectiveness of a plan of controlled regulation in venting suspended matter from a reservoir. For example, on November 2, when sampling showed that the pool of turbid water had reached a condition of equilibrium, it was estimated from the vertical distribution of concentration and the reservoir-capacity curve that 166 tons of suspended sediment were in the entire lake, 43 tons of which were in the turbid pool. However, on the following day it was estimated that 126 tons of sediment were in suspension in the entire lake with only 18 tons remaining in the turbid pool. Thus 40 tons of sediment were no longer in suspension but had either settled to the bottom or had been withdrawn with the water discharged through the sluice gate. From the gate discharge and the suspended-matter concentration in these waters it was estimated that 18 tons of sediment were discharged through the sluice gate. In other words, 45% of the sediment had been discharged through the sluice gate.

Of perhaps more interest is the fact that, in the pool itself, 72% of the suspended sediment passed out through the sluice gate. By keeping the gate discharge at 28.4 cu ft per sec, most of the water in the turbid pool could have been withdrawn. To prevent too great a drawdown in the lake level, the gate discharge was reduced to 15.5 cu ft per sec at 10:25 a.m. and then to 14.4 at 1:50 p.m. on November 3.

Another record of venting sediment begins with the formation of a turbid pool in Lake Issaqueena in the early part of December 1941. The runoff from rains of 2.06 in. on December 3 and 0.63 in. on December 4 also passed through the lake as an underflow. From vertical distributions of concentration taken on December 7 and again on December 9, and from the record of gate discharge and concentration of these waters, it was estimated that during this two-day period 79% of the suspended sediment lost from the pool was vented through the sluice gate.

DESIRABILITY OF CONTROLLED VENTING

The investigation at Lake Issaqueena shows that underflows of sediment-laden water frequently pass through the lake and clearly demonstrates the desirability of wasting water of high sediment content through sluice gates. The practice of venting muddy water has the twofold advantage of reducing the silting rate in the reservoir by withdrawing sediment before it can be deposited, and of permitting the relatively clear surface waters to remain in storage, thus improving the recreational value of the lake.

The mechanics of the flow of the turbid water through the lake is of importance in the study of stratified flow in reservoirs. Whether it mixes with the reservoir water or passes through as an underflow ordinarily is not the problem of the reservoir operator. His problem is primarily a quick and convenient method of estimating the nature and extent of the turbid pool so that the maximum amount of sediment can be vented with a minimum drawdown in the reservoir level. A turbidimeter might possibly be used.

Discharge through the sluice gate depends primarily on the depth of the turbid pool, the density difference, the bottom slope, and the permissible drawdown. In a recreational lake it is desirable that the water should appear clear. The discharge through the sluice gate therefore should not be great enough to draw relatively clear water from that part of the lake above the turbid pool. When there is a choice of conserving clear water or conserving storage space, the conservation of storage by venting as much sediment as possible usually will govern. For maximum efficiency in venting muddy water, several groups of small gates, possibly located at various levels, are preferable to a single large opening.

The author is greatly indebted to the members of the staff of the Sedimentation Division, especially to Alvin G. Anderson, Jun. Am. Soc. C.E., for his assistance in collecting much of the basic data, and to Richard G. Grassy, assistant geologist, who conducted the various laboratory analyses.

Engineers' Notebook

Ingenious Suggestions and Practical Data Useful in the Solution of a Variety of Engineering Problems

Distribution of Wind Stresses in Mast Guys

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DEFLECTION of a mast subsequent to the application of wind loading changes the stresses in the guys. These stresses can be determined by computation similar to that of the following example.

Let us consider a mast with four guys spaced at 90° to one another, Fig. 1. The wind load is assumed to be applied parallel to one of the guy systems. The method of solution for displacements is similar to that used in the familiar Williot diagram. Guy c is increased by an amount Δc; guy a is decreased in equal amount, Δa; and the top of the mast, point D, is displaced an amount Δb.

Considering the windward guy, let the tension, T, be increased to an amount T_x; and the uniform wind loading w, to w_x. From the diagram, Fig. 2, it can be seen that because of the elasticity of the cable there will be an increase in length which can be expressed as $\frac{T_x - T}{AE} C$, where A is the cross-sectional area of the cable, and E the modulus of elasticity of the cable.

Owing to the increased sag resulting from applied wind load, the chord length will be shortened by the amount C_x. Then

$$L + \frac{T_x - T}{AE} C - C_x = \frac{w_x^2 C_x^3}{24 T_x^2} \quad \ldots\ldots (1)$$

$$L - C = \frac{w^2 C^3}{24 T^2} \quad \ldots\ldots (2)$$

Subtracting Eq. 1 from Eq. 2,

$$C_x - C = \frac{w^2 C^3}{24 T^2} - \frac{w_x^2 C_x^3}{24 T_x^2} + \frac{T_x - T}{AE} C$$

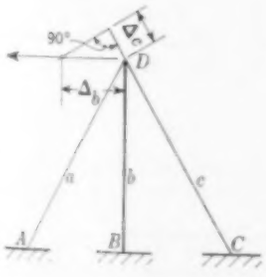


FIG. 1. MAST WITH GUYS SPACED AT 90°

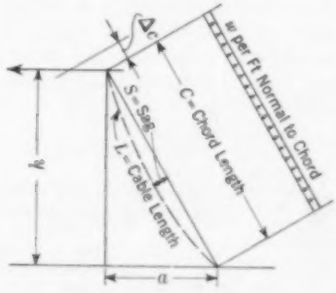


FIG. 2. LOAD APPLIED TO A GUY

Substituting K for $\frac{w^2 C^3}{24 T^2}$ in the preceding, and dropping the factor $\left(\frac{C_x}{C}\right)^3$, since it may be taken as unity without undue error, we get

$$\Delta c = C_x - C = K\left[1 - \left(\frac{w_x T}{w T_x}\right)^2\right] + \frac{T_x - T}{AE} C \quad \ldots (3)$$

Considering the leeward guy, cyclically

$$-\Delta c = K\left[\left(\frac{w_x T}{w T_x}\right)^2 - 1\right] + \frac{T - T_x}{AE} C \quad \ldots\ldots (4)$$

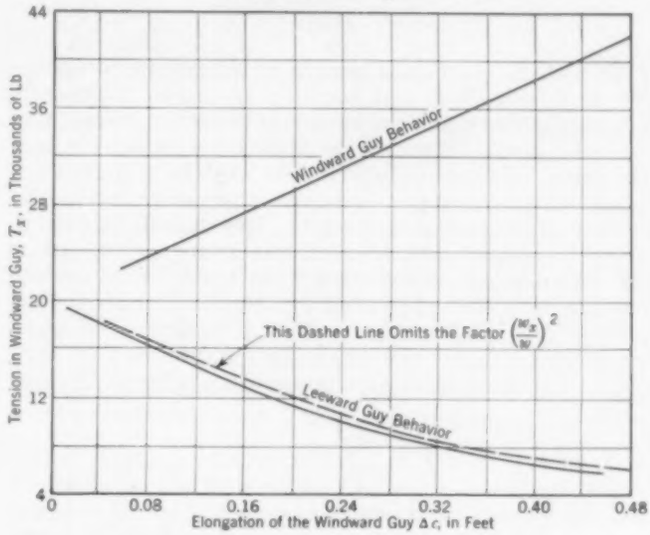


FIG. 3. TYPICAL DIAGRAM FOR WINDWARD GUY RELATING ELONGATION TO TENSION

The load w depends upon characteristics of the cable and fittings, and should be taken as a uniform load normal to the cable. The term T is the tension in the guy before any change in loading. The quantity w_x depends upon the wind and ice loadings assumed. If the term $\left(\frac{w_x}{w}\right)^2$ is neglected, the error will not be large and will be on the side of safety.

Results can be plotted by assuming several values for T_x and solving for Δc. A typical diagram is shown in Fig. 3. The sum of T_x for leeward and windward guys, which is the vertical distance from curve to curve, when multiplied by a/c gives the horizontal resisting force at the point of guy support.

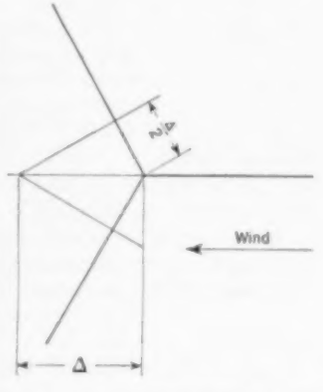


FIG. 4. MAST WITH THREE GUYS

If there are three guys, as shown in Fig. 4, the deflection of each leeward guy will be one-half that in the windward guy. The stress in each leeward guy will be that corresponding to $\Delta/2$. Maximum load in the mast of this system will occur when there is but one leeward and two windward guys.

Because of temperature variations, seasonal adjustments are sometimes made in the length of guys. With a

100° change in temperature, where the guys are at 45° to the mast, the change in length of the guy will be in effect halved by an accompanying change in length of the mast. The change in length per unit length becomes $100 \times 0.0000065 \times {}^1/_2 = 0.000325$. If E for the pre-stressed cable is 24×10^6, then 7,800 lb per sq in. will be added to the stress of the cable. This does not seem to warrant a seasonal adjustment.

If a mast is guyed at several levels, it is suggested that it be assumed straight and the problem solved either by the three-moment theorem or by moment distribution. For unbalanced wind loads, a deflection for a single point can be chosen from such a diagram as Fig. 3. Other points are considered as without moment, and the added stress is calculated. In normal cases this will be small enough to justify neglecting it.

Transits Should Be Graduated in Mils

By PHILIP KISSAM, M. AM. SOC. C.E.

ASSOCIATE PROFESSOR, CIVIL ENGINEERING, PRINCETON UNIVERSITY, PRINCETON, N.J.

ONE of the chief operations in trigonometric computation is adding and subtracting angles. There is practically no reduction of survey notes in which this does not occur. In the course of these operations through the years, millions of dollars must have been wasted because of the time required for this operation and the cost of running down blunders. The absurdity of using degrees, minutes, and seconds to express angles, except for astronomical observations, has been forced on the engineer by a lack of good tables of angular functions expressed in any other form. Today tables can be computed and printed automatically by machines at little cost. The time has come to express angles in decimal units.

SYSTEM ALREADY IN USE PREFERABLE TO NEW ONE

It is the belief of the writer that it is better to adopt a decimal system already in use instead of trying to introduce a new system. Three ways of expressing angles decimally are current today: decimal parts of a degree, the centesimal system sometimes used by the French in which one quadrant contains 100 grads, and the system of mils used by artillerymen in most armies.

One quadrant contains 1,600 mils, a circle 6,400. Fractional mils are always expressed in decimals. One mil subtends approximately a yard at 1,000 yd, so that the sine or tangent of 1 mil is about 0.001. More persons are using mils today than ever before and very probably it is the best known system of expressing angles other than by degrees, minutes, and seconds.

The writer has had the experience of making computations with five-place natural tables, giving a value for every tenth of a mil. The experience is a revelation. The simplicity of adding and subtracting angles and the ease of interpolation are quite amazing. A tenth of a mil is about one-third of a minute, so that a five-place table to tenths of a mil without interpolation gives results with an accuracy that is in close accordance with the usual everyday transit traverse.

CHANGE NOT DIFFICULT FOR INSTRUMENTMAKERS

Now is the time for instrumentmakers to graduate their circles to mils. Thousands of transits are being placed in the hands of artillerymen at this time. For them the first operation is to reduce degrees, minutes, and seconds to mils. To change a graduating engine to mark off mils is not difficult and quite inexpensive. If the instrumentmakers could be assured that tables in mils were available of sufficient accuracy for the engineer's use they would be doing engineers a favor by encouraging their adoption. While there is not so great a choice in types of verniers as with the usual system, two types would probably become standard, one reading to a tenth of a mil (or about 20 sec) for the $6^1/_4$-in. circle, and one reading to a half of a mil (or about 100 sec) for the smaller circles. A single vernier of each type would appear as shown in Fig. 1.

This suggestion may be criticized by those who have never used mils. The lawyer who has had no military experience may have a bad five minutes when he sees his first land description written in mils. The transitman who records his first angle in mils may have a curious sensation. But no one who has used mils a few times will ever go back to degrees, minutes, and seconds by choice.

FIG. 1. SINGLE VERNIERS—TWO SUGGESTED TYPES

(*a*) Type for Larger Circles. Setting Illustrated Reads 426.8 Mils (3.375 Min = 1 Mil). Length of Vernier Is About 14 Deg of Arc. This Vernier Reads to 0.1 Mils or About 20 Sec. (*b*) Type for Smaller Circles. This Setting Reads 446.5 Mils. Length of Vernier Is About 11 Deg of Arc. This Vernier Reads to Half Mils or About 100 Sec

ADVANTAGES SUMMARIZED

The advantages of the use of mils are the following:

1. Angles are expressed with fewer symbols, for example:
   $78°22'15''$ = 1,393.26 mils (to the nearest 2 sec)
   $78°22'$ = 1,393.3 mils (to the nearest 20 sec)
2. Angles can be added and subtracted more easily.
3. There is less chance of misreading angles in mils.
4. Interpolation in any table is easy and no interpolation would be necessary in a five-place table for the usual transit accuracy.
5. Quick approximate angular computation is simple when small angles are used; 1 mil = 1/1,000 radians to an accuracy of better than 1 part in 500.

Many advances are made in wartime that would never be contemplated in times of peace. Why not make the effort now?

OUR READERS SAY—

In Comment on Papers, Society Affairs, and Related Professional Interests

Membership of Society Committees

TO THE EDITOR: In preparing for a discussion of the subject, "Selection of Society and Section Committees," at the recent Spring Meeting at Roanoke, I thought it would be of value to analyze the committee membership—as listed in the front of the Year Book for 1941—as to geographical distribution and then to determine the classification of the committee membership by types of employment and compare the results with similar distribution for the Society as a whole.

The 1941 Year Book was used to make the distribution of the committee members both as to geography and type of employment. The Year Book, of course, stated the total membership in each state. The distribution of the total Society membership as to type of employment was a close approximation taken from the classification, prepared by the Society staff, of the persons to whom CIVIL ENGINEERING is mailed.

In view of the interest in the results of this survey expressed at the Local Sections Conference at Roanoke, I believe that this letter would be of interest to our members.

DISTRIBUTION OF COMMITTEE PERSONNEL BY STATES

State	Society Membership	Committee Membership	Ratio	State	Society Membership	Committee Membership	Ratio
Iowa	157	15	10	Ga.	174	4	44
Mass.	502	46	11	Maine	44	1	44
S.C.	117	10	12	Texas	776	17	45
Minn.	189	14	13	Ohio	602	13	46
Ill.	830	56	15	R.I.	94	2	47
Miss.	102	7	15	Nebr.	97	2	48
Md.	266	18	15	Kansas	148	3	50
Colo.	278	18	15	Ariz.	115	2	57
N.Y.	2,518	148	16	N.C.	146	2	73
Conn.	222	13	17	Wis.	168	2	84
Pa.	1,150	63	18	Fla.	183	2	92
Mo.	438	24	18	Wash.	390	4	97
D.C.	696	37	19	N. Mex.	98	1	98
Ore.	213	10	21	Ky.	108	1	108
Ind.	208	10	21	Okla.	129	1	129
N.J.	454	18	25	Idaho	57	0	...
N.H.	51	2	26	Mont.	51	0	...
Del.	55	2	27	Nev.	27	0	...
Tenn.	409	15	27	N. Dak.	25	0	...
Ark.	86	3	28	S. Dak.	24	0	...
Calif.	2,043	68	30	Utah	100	0	...
Ala.	149	4	37	Vt.	24	0	...
Va.	298	8	37	W. Va.	120	0	...
Mich.	349	9	39	Wyo.	45	0	...
La.	210	5	42				

DISTRIBUTION OF COMMITTEE PERSONNEL BY EMPLOYMENT

Group	Types of Employment	Percentage of Society Membership	Percentage of Committee Membership
A.	Cons. and arch. engrs. and their staffs...	14	34
B.	Construction and gen. contracting companies, engr. officials, engrs. and their staffs, and comm. org.....	12	4
C.	Public utilities, officials, engrs., and staffs.	3	3
D.	Industrial org., officials, engrs. (construction, plant maintenance, etc.), and their staffs.....	9	6
E.	Transportation, railway, airway, and waterway, officials, engrs., and their staffs.....	3	3
F.	Fed. gov. officials and engrs., and foreign government engineers	21	14
G.	State and county officials and engrs.	10	6
H.	Municipal officials and engineers.....	8	5
I.	Professors of engineering and engineering school libraries.....	6	24
J.	Engineering assoc., publications, retired engineers, students, and miscellaneous	14	1

In an organization as large and widespread as ours, the selection of committee personnel is undoubtedly a difficult undertaking. Factors such as special knowledge of the subject matter must be considered, but it is my belief that the sum total of the committee membership should represent roughly a cross section of the whole Society membership, thus taking advantage of the full strength of the membership. My limited observation has convinced me that members generally welcome the opportunity to serve on Society committees, although I have no way of knowing what percentage of committee appointments is refused or what percentage of committee members fails to function.

CHARLES W. OKEY, M. Am. Soc. C.E.
President, Tennessee Valley Section

Knoxville, Tenn.

Comments on Integral Centering for Concrete Arch Ribs

DEAR SIR: In regard to Mr. Serber's article, "Integral Centering for Concrete Arch Ribs," in the August issue, I would like to point out that the interesting method he describes has previously been used to advantage in bridge construction. The Belle Isle Park Bridge, which spans one branch of the Detroit River, is a multiple-arch bridge, with a structural design on this basis, prepared by Prof. Lewis M. Gram. The structure was built about 25 years ago.

In addition to the economies made possible by this method, and noted by Mr. Serber, there is also some saving in the concrete rib itself. Inasmuch as the integral centering carries all the dead load, thereby introducing what amounts to a prestressing of the steel, the reinforced arch itself carries only live load. This live load causes all the stress in the concrete, and additional corresponding stresses in the steel.

The consulting architects on the asphalt mixing plant for the Manhattan Department of Borough Works, described by Mr. Serber, were Ely Jacques Kahn and Robert Allen Jacobs, who suggested the vaulted structure both as a logical housing for the equipment and as an interesting mass. The consulting mechanical engineers were Syska and Hennessy.

JAMES B. NEWMAN, M. Am. Soc. C.E.

New York, N.Y.

Volumes by Prismoidal Formula

TO THE EDITOR: The method of calculating earthwork end areas, described by Mr. Fergusson in the June issue, was expanded by the writer more than twenty-five years ago into a formula for the volume of prismoids, pyramids, and wedges, which has been found satisfactory in applications to a variety of volume computations ranging from tiny metal parts through massive concrete structures to earthwork.

Being based on the prismoidal formula, the volumes computed by the formula are exact. The formula for the volume, V, between parallel end faces of areas A' and A'', a distance L apart, and the corresponding coordinates whose corner points are, respectively, in order around the faces, $x'_1, y'_1;\ x'_2, y'_2,\ \ldots x'_n,\ y'_n;$ and $x''_1, y''_1;\ x''_2, y''_2;\ \ldots x''_n, y''_n;$ is:

$$V = \frac{L}{12}\left[(2x'_1 + x''_1)(y'_n - y'_2) + (2x'_2 + x''_2)(y'_1 - y'_3) + \ldots + (2x'_n + x''_n)(y'_{n-1} - y'_1) + (2x''_1 + x'_1)(y''_n - y''_2) + (2x''_2 + x'_2)(y''_1 - y''_3) + \ldots + (2x''_n + x'_n)(y''_{n-1} - y''_1)\right] \quad (1)$$

or

$$V = \frac{L}{12}\left[\sum_{i=1}^{n}(2x'_i + x''_i)(y'_{i-1} - y'_{i+1}) + \sum_{i=1}^{n}(2x''_i + x'_i)(y''_{i-1} - y''_{i+1})\right] \quad (1a)$$

The formula as given above is independent of the end areas. If the areas and coordinates of the corner points of the end faces are known, the prismoidal formula reduced to the following convenient form may be used:

$$V = \frac{L}{12}\left[4A' + 4A'' + \sum_{i=1}^{n} x'_i(y''_{i-1} - y''_{i+1}) + \sum_{i=1}^{n} x''_i(y'_{i-1} - y'_{i+1})\right] \quad . \quad . \quad . \quad . \quad (2)$$

which does not require computation of the area of the mid-section, or of the coordinates of its corner points.

The summations in all cases are to go once around the figures, y_i is taken as y_{n+1}, and y_n is taken as y_{i-1} for $i = 1$. It is not necessary that a line connecting the origins of the coordinate systems of the two faces be perpendicular to the faces. When, as is often the case, a side face of the prismoid is triangular, the coordinates of the corner point on the apex end must be repeated in connection with the coordinates of the corresponding corner point on the opposite end face. Thus, in computing the volume of a hexagonal pyramid the coordinates of the apex are used six times. The number, n, of pairs of coordinates must be the same for each end face and may, with repetitions, be greater than the number of sides of either; it will always be the same as the number of sides of a section taken at any point between the end faces. As stated, the formulas give positive volumes when the coordinate axes are conventionally assumed and the coordinate subscripts are numbered in a clockwise direction around the end faces. In other cases, as when the x's and y's are transposed as in earthwork notes, the volume may appear as a negative quantity if the differences of the y's are not reversed throughout to $(y_{i+1} - y_{i-1})$, but its absolute value will be correct by Eqs. 1 or 1*a*, though not by Eq. 2. The sum of the successive products may be accumulated in the dials of the computing machine without transcribing any figure but the total volume.

LAURENCE T. FLEMING

Chicago, Ill.

Bridge Proposed But Not Built

TO THE EDITOR: Some day someone will write a book on types of bridges that never existed save in the minds of their enthusiastic proponents. The composite structure illustrated herewith might serve for the frontispiece.

Such a book would not be complete without a description of Thomas Pope's "Flying Pendent Lever Bridge" over the Hudson, the fond dream of a self-styled "architect and landscape gardener" of 1811. Perhaps even the great Telford's 600-ft cast-iron arch, which (in 1801) was to span the Thames, might also be included. "If they will provide the ways and means," averred the master, "and give me elbow room, I see my way as plainly as mending the Brig at the auld Burn." Some of Telford's friends had enormous two-guinea prints of the 6,500-ton monstrosity struck off (I wish I had one); fortunately other friends restrained his Scottish exuberance and thereby preserved his reputation untarnished.

Refer now to the "beautifully picturesque" illustration of Mr. Jordan's patent suspended bridge, reproduced here. Note the particular interest of this type to students of secondary and tertiary, not to mention indeterminate, stresses. The counterweights are apparently expected to move along atop the arch ribs—the drawing is not any too clear on this point. Do not fail to remark the uncanny skill of the navigator of the little craft. The following extracts from the claims of the inventor and his confident supporters were recorded in the *Monthly Magazine* and *British Register* for December 1796, and January 1797:

"Letters Patent have been granted to Mr. James Jordan for his invention of a mode of constructing bridges, which unites simplicity, cheapness, durability, and an easy mode of erection, in situations where, to build other bridges might be found difficult, if not impracticable.

"The great cause of damage having hitherto arisen from piers which are continually weakened and impaired by the action of the water, and of sheets of ice, floods, etc., the present patentee, to avoid these, in some cases entirely and in others partially, proposes to derive his support from above, and not from below as in the usual way. His plan is to place two parallel elliptic curves across the intended site, formed of cast or wrought iron, or wood, and springing from sufficient abutments. He then proposes to attach the bridge to these curves, by means of wrought iron suspending bars, at any height from the water that may be required.

"The bridge of one span and that of several spans have, in the drawing, an appearance beautifully picturesque. The road over them, as suspended by the cast-iron curves, forms a sort of chord to the curve line, and they possess this very peculiar utility, that they are perfectly straight and flat, and have no rise or crown, as in bridges of the present construction."

* * * *

"It will be obvious to every intelligent person, that bridges built on Mr. Jordan's plan, possess considerable advantages in the following particulars:

"1. They require less time to execute, particularly as they will not be subject to the interruption of tides.

"2. They may be erected with greater ease, and at a less expense

"3. They will be easier of ascent.

"4. They will not be so liable to decay.

"5. They may be repaired with more certainty and facility, and at a much smaller expense.

"6. They will not be subject to the accidents that have destroyed others.

"7. They can be erected of any extent, as well in regard to length as width.

"8. They can be so secured and combined, as to form as it were one entire piece.

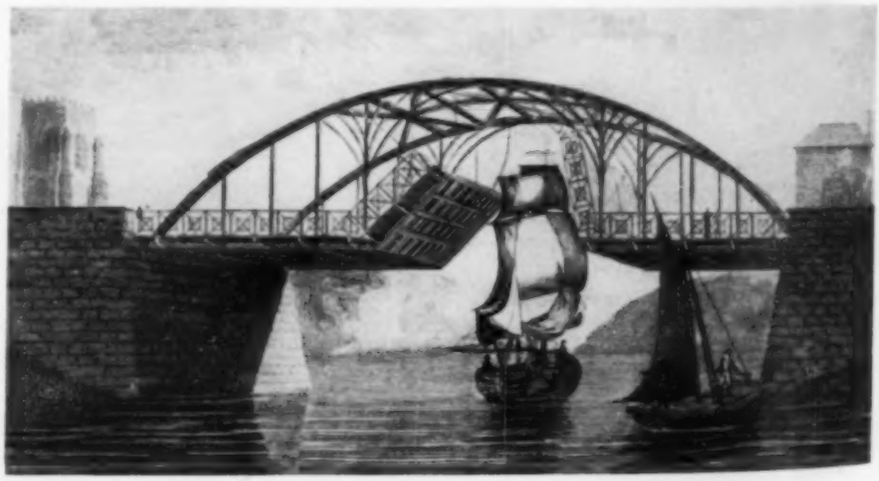
"9. Their parts can be secured from decay of an accidental nature, and assisted in their durability by the application of different preservatives.

"10. Lastly, it is clearly evident, on inspection, that bridges of this construction, whatever their length, are in no respect subject to the continual accidents which arise to bridges on the common construction, from currents, tides, swells, inundations, etc."

We may well speculate on how some of today's proposed structures will appear in the light of advancement of, say, a century hence.

RICHARD S. KIRBY, M. Am. Soc. C.E.
Associate Professor of Engineering Drawing, Yale University

New Haven, Conn.



EIGHTEENTH CENTURY PATENTED SUSPENDED BRIDGE

SOCIETY AFFAIRS

Official and Semi-Official

Niagara Falls, Canada, Scene of Society's Fall Meeting

Plans for Interesting Joint Sessions with Engineering Institute of Canada

MEETINGS and other Society activities proceed under many handicaps nowadays. Yet they serve a beneficial purpose in direct furtherance of war activities. Hence, the Board of Direction, when it considered these questions at the time of the Annual Convention in Minneapolis this summer, went on record as approving the continuance of the quarterly meetings. It selected Niagara Falls, Ontario, for the 1942 Fall Meeting. The dates set are Wednesday and Thursday, October 14 and 15, as previously announced in these pages.

JOINT MEETING WITH CANADIAN ENGINEERS

This meeting will be held jointly with our engineering colleagues of the Dominion of Canada, working with their national organization, the Engineering Institute of Canada. Bonds between that society and ours are strong and many engineers are members of both. This meeting should serve to renew and strengthen both personal and professional ties.

Following the Society's current policy, the general theme of the program will be the work of the civil engineer in the successful prosecution of the war. Since the problems of civil engineers throughout the world are similar in many ways, it is certain that our Canadian associates will have some very interesting matters to present at this meeting. An exchange of experiences should benefit alike engineers from the Dominion and those from the States.

HEADQUARTERS HOTEL CHOSEN

The General Brock Hotel has been selected as Headquarters for the Meeting and has been reserved completely for the use of those in attendance. This famous hostelry is located at the Canadian end of the newly constructed Rainbow Arch Bridge. An excellent front view of both the Canadian or "Horseshoe Falls" and the so-called American Falls is to be had, as demonstrated by the accompanying photograph.

LOCAL SECTIONS CONFERENCE

On Tuesday, October 13, twenty Local Sections will send representatives to an all-day conference. Two matters of general interest and vital importance will be discussed—Civilian Protection in War Time, and Employer-Employee Relations in the Engineering Profession. Local Section representatives and some of the Canadian engineers will be asked to report on both these subjects, with reference to their respective areas. At this conference Howard F. Peckworth, Assistant to the Secretary, will present his findings on Employment Conditions. He has traveled some 16,000 miles and talked to more than 1,500 engineers in the past five months, during which all of his time has been devoted to a thorough study of the subject. Related to this topic will be a discussion by a member of the Institute's Committee on Salaries and Fees.

Of course, there will be time reserved at this conference for a general discussion of Local Section activities and administration.

The following Sections are expected to be represented—all others having been invited to cooperate at either the Spring Meeting at Roanoke, Va., or the Annual Convention at Minneapolis, Minn.:

Buffalo	Ithaca	Philadelphia
Central Ohio	Lehigh Valley	Pittsburgh
Cincinnati	Maryland	Providence
Cleveland	Metropolitan	Rochester
Connecticut	Michigan	Syracuse
Dayton	Mohawk-Hudson	Toledo
District of Columbia	Northeastern	

TECHNICAL DIVISIONS PLAN ACTIVITIES

Specific plans for the programs of the Technical Divisions have not advanced sufficiently to permit the publication of precise details in this issue of CIVIL ENGINEERING. However, the following six Divisions are now working on programs which promise to be of interest and value: Construction, Engineering Economics, Highway, Power, Structural, and Surveying and Mapping.

Technical Division chairmen and others are assisting in developing the programs. They are working in close cooperation with members of the Institute, and it is expected that at least one member of the Institute will participate in the preparation of the program of each Technical Division. These will thus be truly joint sessions.

VIEW OF BOTH AMERICAN (LEFT) AND CANADIAN FALLS (RIGHT) FROM SUN DECK OF GENERAL BROCK HOTEL

The Fall Meeting will be officially opened at 10 a.m. on Wednesday, October 14, with words of welcome by local leaders from the Canadian group and our own. President Young of the Engineering Institute of Canada, and President Black of the Society, will give brief addresses.

The remainder of the Wednesday morning session will be devoted to the subject of "Man Power Control," to be discussed by officials of the Canadian and United States governments. Following these presentations, there will be ample opportunity for questions from the floor to be answered by either of the two speakers.

CIVILIAN PROTECTION

Although much has been said and written on the subject of Civilian Protection in War Time, new developments are continually being made. On Wednesday afternoon one session will be devoted to this subject, sponsored by the Society's National Committee on Civilian Protection in War Time. Here again those from south of the line will benefit by the full cooperation and par-

ticipation of our Canadian friends. Their problems and their solutions should be a valuable contribution to the general knowledge on the subject.

This subject will also be discussed in intimate detail at the Local Sections Conference on Tuesday.

NIAGARA FALLS AND SURROUNDING ATTRACTIONS

Hardly a more picturesque location could have been chosen for the Joint Meeting with our engineering friends across the border. From many individual rooms, and from the Sun Deck and Rainbow Roof of the General Brock Hotel, one can have an uninterrupted view of both the Canadian and the American Falls—one of America's breath-taking spectacles. Rates at the General Brock vary from $6 per day for rooms facing the Falls to $3 a day without this view.

It is hoped that arrangements can be made for those attending the meeting to visit the great hydroelectric developments at the Falls. It is wartime and such plants are closed to visitors as a general rule, but attempts are being made to allow visiting engineers this privilege, and that of seeing other nearby engineering works of interest. One of the more recent engineering projects to be seen at Niagara is the Rainbow Bridge, which gracefully spans the river below the Falls. The famous Welland Canal also is only a few miles distant. Remedial works in the Niagara River about the Falls are also in progress.

BRING THE LADIES

Of course there will be ample opportunities for the visiting ladies to become acquainted and enjoy themselves while their husbands are engaged in "talking shop" at technical sessions. The Falls has ever been a popular spot, and a romantic one, with an appeal for both men and women, young and old.

Since "all work and no play makes Jack a dull boy," a few social events are scheduled for this Fall Meeting, primarily to permit Society members to meet those of the Institute. All discussion of civilian protection, hydraulics, or highways will be forbidden during the proposed dinner dance on Wednesday night. It is to be listed as "formal." But don't let that keep you away!

ENTERING AND LEAVING CANADA

Full authoritative information respecting the formalities of procedure for entering and leaving Canada will be published in the October issue of CIVIL ENGINEERING. However, it may be stated briefly that for citizens of the United States, all that will probably be required is reasonable identification of the sort usually carried in one's pocket, such as driver's license, hotel credit cards, membership cards of various organizations, or even business letters.

Anyone desiring information in advance of the October issue of CIVIL ENGINEERING may write to the Department of Transport, Ottawa, Canada, asking for its booklet entitled "How to Enter Canada." You may be sure that the Canadian immigration and customs officers will cooperate to minimize formalities and delay.

RAILROAD FACILITIES

The city of Niagara Falls, Ontario, is situated just across the Niagara River from Niagara Falls, New York. Main rail connections are through Buffalo, N.Y., which is served by fifteen railroad lines, including many of the larger railroads. Rail lines also come through Ontario from the West. Of course the Canadian centers of Hamilton, Toronto, Kingston, Ottawa, Montreal, and Quebec are well served. It is hoped that a brief tabulation of the main schedules of interest to railroad travelers may be included in the October number.

Meeting of Board of Direction—Secretary's Abstract, July 20, 1942

THE BOARD OF DIRECTION met at the Center for Continuation Study, University of Minnesota, on Monday, July 20, 1942, with President E. B. Black in the chair and Secretary Seabury and the following members of the Board in attendance: Past-Presidents Hogan and Fowler; Vice-Presidents Burdick, Stevens, Spofford, and Stanton; and Directors Blair, Boughton, Carey, Dickinson, Dunnells, Goodrich, Howard, Hyde, Lilly, McNew, Polk, Requardt, White, and Wiley. Regrets were received from Directors Burpee, Cowper, Cunningham, and Massey.

Approval of Minutes

Minutes of the meeting of the Board for April 20, 1942, were slightly amended. Otherwise these minutes and those of the Executive Committee meeting for April 19 were approved as written.

Dues

After discussion, and following recommendation of the Executive Committee, dues of certain members in the military service were canceled.

J. Waldo Smith Hydraulic Fellowship

Upon recommendation of the committee having administrative charge of the J. Waldo Smith Hydraulic Fellowship, it was decided that no award of this fellowship be made for 1942–1943.

Daniel W. Mead Prizes

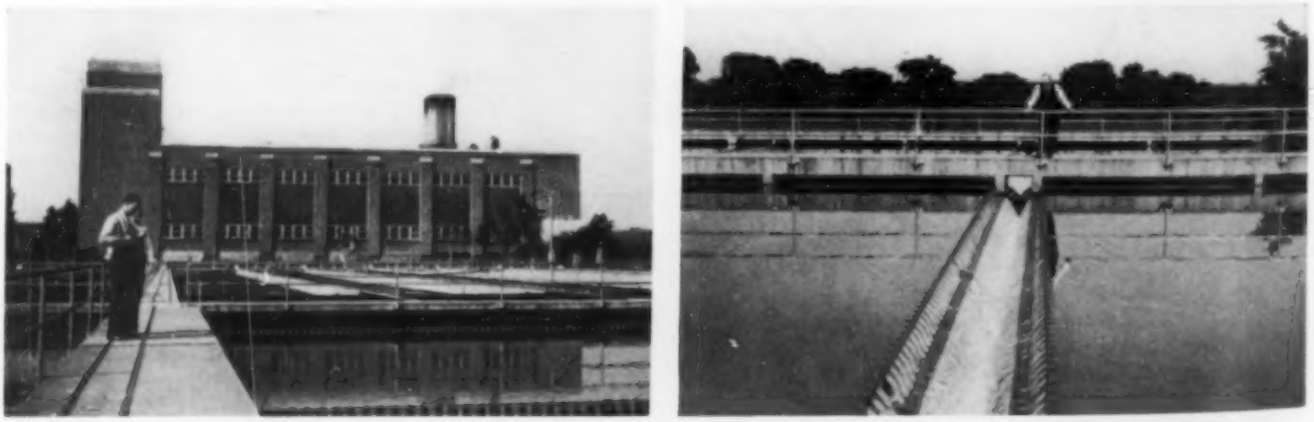
Because of conditions incident to the war, it was decided that further award of the Daniel W. Mead prizes be deferred until conclusion of peace.

Appropriations

Requests for changes in current appropriations for committees and Divisions were considered and acted upon.

Acting Assistant Secretary

In the place of Walter E. Jessup, M. Am. Soc. C.E., who was given leave of absence to enter active military service, James E. Jagger, M. Am. Soc. C.E., Field Secretary, was appointed Acting Assistant Secretary.



Courtesy A. M. Rawn, M. Am. Soc. C.E.

INSPECTION OF MINNEAPOLIS–ST. PAUL SEWAGE TREATMENT PLANT, AT ANNUAL CONVENTION IN MINNEAPOLIS, JULY 23, 1942
Left, Filter and Incineration House; Right, Overflow Weir

Fall Meeting

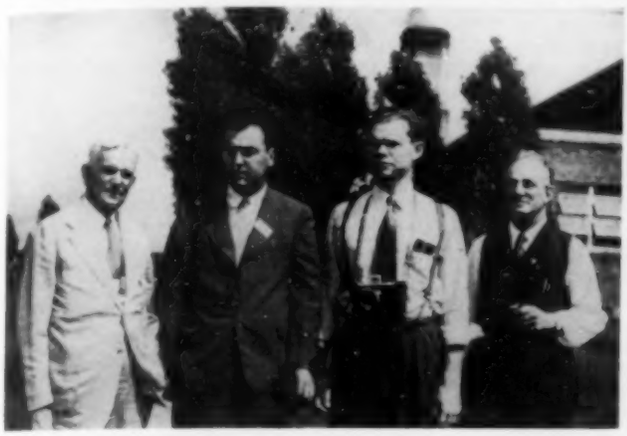
It was decided to hold a Fall Meeting of the Society at the General Brock Hotel, Niagara Falls, Ontario, Canada, jointly with the Engineering Institute of Canada. (See item page 521.)

Future Meetings

Readopting the practice of holding quarterly meetings, the Board asked that the Vice-Presidents of the Society report on times and places for 1943 Society meetings; and that with respect to meetings and otherwise, the Society continue its normal activities in so far as it can do so without interfering with the war effort.

Employment Conditions

Report was received from H. F. Peckworth of the Headquarters staff, assigned particularly to employment problems, with respect to a four-month's study he had made of labor laws, the attitude of engineers towards unionization, and groupings of engineer employees throughout the country. (See item on another page.)



Courtesy A. M. Rawn, M. Am. Soc. C.E.

AT INSPECTION OF MINNEAPOLIS–ST. PAUL SEWAGE TREATMENT PLANT, ANNUAL CONVENTION

Charles B. Burdick of Chicago; George J. Schroepfer, Chief Engineer and Superintendent of Plant; Carl E. Green of Portland, Ore.; and Prof. Charles Gilman Hyde of Berkeley, Calif.

Washington Report

An account of Society activities and matters affecting the interests of civil engineers, centering at the national capital, was presented by Hal H. Hale, Society representative in Washington. A summary appears elsewhere in this issue. A conference committee re profits and excess profits on architect-engineer contracts was authorized.

Publications

On recommendation of the Committee on Publications, the Board authorized publication of a manual on hydraulic models and the resumption of normal size of PROCEEDINGS for the remainder of the year.

Timber Structures

As recommended by the Committee on Division Activities, the Structural Division was authorized to appoint a Committee on Timber Structures.

Division Executive Committees

A proposal, also emanating from the Committee on Division Activities, related to a proposed change in the By-Laws, with respect to selection of members of the respective executive committees of the Divisions. Formal notice was given of a proposed change in Article VIII of the By-Laws, Section 3, to provide that:

"The members of the Executive Committee shall be appointed by the Board from nominations made by the Division Executive Committees."

Final action on this amendment will take place at the October Board Meeting.

Committee on Cavitation

Request was received from the Committee on Hydraulic Research of the Hydraulics Division for funds to inaugurate work on "Cavitation in Hydraulic Structures." After discussion and oral report from J. C. Stevens, chairman, necessary provisions for this committee work were adopted.

Post-War Planning

After full discussion, the Board went on record as favoring a well-thought-out program of planning for post-war engineering work, with suggestions as to implementing this policy.

Arizona Section Amends Constitution

Permission was given to the Arizona Section to amend its Constitution in conformity with regular Society policy.

Appointments

Representatives to serve the Society on committees and as representatives were authorized.

Other Reports

Various committees of the Board reported on their current activities and problems.

Membership

Consideration was given to a number of matters transmitted by the Committee on Membership Qualifications, on which the Board came to definite decision.

Miscellaneous Matters

A number of routine requests, communications, and reports were received, with individual action in each instance.

Adjournment

The Board adjourned Monday evening to meet at Niagara Falls, Ontario, Canada, on Monday, October 12, 1942.

The Engineer in Foreign Service

III. Banditry in Southern Persia

By L. M. WINSOR, M. AM. SOC. C.E.

From time to time "Civil Engineering" has had the privilege of quoting experiences of Society members in distant places. Two such accounts—from Burma and Trinidad—appeared in the August issue (pages 465 and 469). A third is given here. Mr. Winsor left Salt Lake City in September 1941 on an assignment covering a number of months or years as consultant to the Ministry of Agriculture of Iran (Persia) on matters of water conservation. This account of his experiences has been extracted from letters read before his engineering friends at a meeting of the Utah Local Section.

Sheraz, Iran
January 26, 1942

"I AM on my first long trip through Southern Persia, and have just had an adventure that, but for the Providence of the Lord and the persistent vigilance of my two faithful and loyal servants, might have cost me my life.

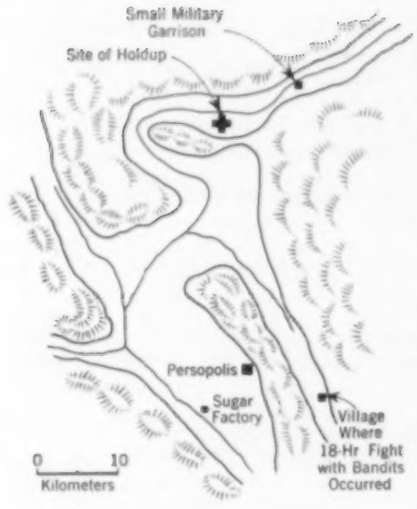
"We were traveling south from Ispahan and were just entering a long winding valley bounded on both sides by high, rugged, barren mountains, when we were held up by twenty brigands in the real, old-fashioned, legendary manner of a hundred years ago. The location is about 40 km north of the ancient capital of Media, which flourished during the reign of Cyrus the Great, 500 B.C.

"As we approached the foot of the rugged cliffs where deep, narrow, winding gorges penetrate far into the mountainside, I remarked to myself, 'What a setting for banditry.' Suddenly it was changed from contemplation to reality. Two British lorries had already been stopped and we were forced to slow down because the road was blocked by the trucks. Suddenly from ambush two long rifles appeared. Then the rugged slopes seemed to be alive with brigands.

"I was riding in the front seat and was not molested for a time for in Persia the 'big shots' always ride in the back. My associate and my personal secretary and helper were dragged from the car and stripped of their clothing. Then I was relieved of my money, my glasses, camera, watch, etc.

"Then two other cars were observed to have stopped about 1/2 km up the road and one was turning around. My driver was forced to turn his car around and drive back in an effort to stop these two machines. They caught one, but the other got safely away, and notified a small garrison of soldiers that were quartered 8 km farther up the valley. But the soldiers were slow in responding and did not appear until the bandits were well out of the way, with the long night ahead.

"Meanwhile attention of the group had been focused upon me and some were quite determined that I should be shot. One of them started the cry that I was English. Another, who was at that



SKETCH MAP OF AREA DESCRIBED

time on top of the closest lorry said, 'Who is the Englisher, show him to me and I will shoot him.' Another came running up and said: 'You are Englishman, you have taken our country; now we will take you to execution field.' He gathered hold of me and endeavored to pull me away, but I broke his hold and stepped back to my car that had returned. My driver and my secretary made a desperate effort to convince the mob that I was not English but was an engineer who had come to help them with their water problems. The secretary showed them our instruments, then showed them his prayer symbol of polished clay and told them that he was a Mussulman from Meshed and swore by Allah and all the saints and prophets that I was not English.

"Still they were not satisfied and three nasty looking, old-fashioned muskets of ancient vintage were leveled at me. My driver had also very eagerly pleaded and swore by God and the Prophets that I was not English. Finally he stepped in front of me and said, 'If you shoot him you must shoot me first.'

"Just then the leader shouted, 'Take your packs and run for the mountains, the soldiers are coming!' So they left me and ran. The leader stayed behind to complete the examination of my baggage; then he went a short distance up the slope and stood guard until we left.

"We went back to the caravans where the soldiers were stationed and spent the night.

"There we borrowed enough clothing to serve our momentary needs, and money enough to carry us to Sheraz, where the Governor General fixed us up with new clothes and other necessities.

"I have received royal treatment from all officials here and telegrams of apology and assurance of complete restitution from officials at Teheran, together with the assurance that the culprits will be apprehended and hanged at the scene of their crime. Already thirteen suspects have been brought to prison here and I have looked them over carefully. They answer the general description, except for a few individuals whom we are sure we did not see at the holdup. The stories about their capture are confused so I am not at all sure that these are the men."

January 29, 1942

"Since I was writing two days ago, I have spent one day in a series of conferences and I have revisited the military prison and have made a short trip to near-by agricultural projects. Yesterday, at the request of the General who is in charge of military forces in Southern Persia, I accompanied the Colonel (commander of local forces) to the village where the prisoners were captured. We were heavily armed and were preceded by an escort of twenty soldiers. It appears that the men put up a desperate resistance for 18 hours, then surrendered after the base of the tower where they were barricaded was set in flames by means of gasoline-soaked inflammables.

"I saw the signs of the conflict, and the collection of old guns that looked as if it had been taken from an Arabic or Turkish antique shop. The General has promised to give me one of these as a trophy.

"The wretched condition of the villagers and the village and the terrified pleading of the women and children made my heart bleed, and I shall never forget it. It makes me more determined than ever to devote my energy and talent such as I have to the relief of these poor people. There was not enough food and clothing in that village to serve the needs of one family. Most of the men, as well as the women and children, were barefooted; it was heart-rending to witness such absolute poverty and misery. I went into one hovel where two little children were shivering in a dark corner. They were terrified at first, but I made them understand that I would not hurt them and was rewarded by a smile and a mumbled 'God bless you' when I handed them some small change.

"Today I am going to dine with the Governor General, and I hope to impress him with the need for solving their crime problem, not by hanging a few unfortunates who happen to be caught, but by making it possible for the people to provide for themselves a decent living.

"As you see by the sketch enclosed, the village referred to is just over a chain of low hills from Persopolis, and Persopolis is in a large valley now nearly desolate for lack of water on the land, but there is a river of considerable size flowing by. The older diversions have gone to ruin and need only to be repaired to provide life-giving water to that fertile soil. There is a new sugar factory nearby that runs at 25% capacity because the sugar beets cannot be grown in sufficient quantity within reach of the factory, and the crop, such as it is, must be carried in on the backs of donkeys or camels. Meanwhile the nation is rationing sugar to the people and monopolies have developed which control the product and the price so that the poor people must go entirely without. In one of the recent robberies the bandits took sugar only and let it be known why they took it.

"There are several sugar factories in the country and none is running to as much as 50% capacity. One of my jobs will be to put the water on the land in the vicinity of these factories so that each can increase its output to near maximum capacity, and at the same time give employment to more and more of these poor unfortunate people.

"At present there is a tremendous percentage of these poor villagers who smoke opium, one of the local products of the soil. They do it to ease the pains of hunger in many cases. When one sees their wretched condition, he is minded to say, 'I do not blame them for trying to forget their pain for even a little while.'

"Tomorrow and the next day I am to see the country nearby, including a part of the valley near Persopolis that is going to ruin and requires rebuilding. Then we will take a military escort and make a study of a string of valleys far up the river and down the river to where the surplus waters enter a salty sea. I expect to find many opportunities for helping to develop the country, and to locate a number of sites where the storing of water may be possible.

"It gives me a real thrill of satisfaction to realize how badly my particular brand of service is needed by a people who respond so readily to kindness and real understanding, and I am truly thankful that my life has been spared to render service that is needed so much.

"I have met many wonderful characters of both high and humble rank, and all have reacted favorably and with enthusiasm to the frank, straightforward manner that I have adopted in discussing plans of procedure which are sure to be helpful to the country and to improve conditions for the common people. I have told the men in high office that I want to spend my time planning and providing projects that can be built with limited capital by those people who will be directly benefited, and with the materials that are at hand, rather than to start big and expensive structures which might not be completed, and which, if completed, would be chiefly beneficial to the men who are already wealthy. My sincerity in wanting to help the people who are located on the land, or who would gladly work on the land if they had reasonable chances of proceeding, has struck such a responsive chord that I am confident of making a real success of my assignment here in Persia."

Hundreds of Engineers Move to New Work

TO DIRECT the construction of cantonments, warehouses, industrial plants, and island bases, a large army of members of the Society (civilian as well as military) has been on the march since the very beginning of the emergency period. As the construction effort becomes more intense, increasing numbers pack up their belongings and move to the spot where they are most needed.

This activity is evidenced by the change-of-address pamphlet that is sent each month to secretaries of Local Sections. An unusually large number of changes were recorded in the August issue, listing changes of address that occurred in July, when over six hundred men reported moving.

Washington in War Time

By HAL H. HALE, M. AM. SOC. C.E.

ASSISTANT TO THE SECRETARY OF THE SOCIETY

At the July Meeting of the Board of Direction in Minneapolis, Mr. Hale reported on conditions in Washington, D.C., particularly as they affect civil engineers and the civil engineering profession. A digest of some of his more important findings is given here. This report was supplemented by an intimate appraisal of the personal or political circumstances related to some items of prospective legislation. All the questions received thorough discussion by the Board.

ACTIVITIES in Washington have been on the increase for the past several months. Some of the developments and their implications to the civil engineers of the country will be summarized briefly.

WAR MANPOWER COMMISSION

This spring, the President, by executive order, established a War Manpower Commission under the direction of former Governor Paul McNutt, of Indiana. Its stated objective is the proper mobilization of American manpower for the all-out war effort. Such a program naturally involves the professions.

The War Manpower Commission has taken over the U.S. Employment Service as a part of its operations, as well as the National Roster of Scientific and Specialized Personnel, and both agencies will be utilized in the placement of all personnel, including civil engineers. Civil engineers, likely to be dislocated in their employment, should register with their local U.S. employment offices, as it is to these rolls that the Manpower Commission will turn.

Several statements of policy have been issued by the Commission, some directed at the Selective Service System. While there have been numerous statements issued regarding the shortage of engineers, the question is still open to debate and discussion, particularly with reference to civil engineers, although they have been listed as one of the "critical occupations."

RECRUITING FOR THE ARMED SERVICES

Recruiting officer personnel for the armed services has slackened somewhat and recruiting terms have become more stringent. Lessening of opportunities in this field may be anticipated, for the time being at least. It is stated authoritatively that the peak of new enrolments has about been reached, and that beginning in September it will be possible to transfer officers now engaged on construction work to field and combat duty. Any appointments that are made from civilian life will require that the appointee have at least basic military training.

The only active recruiting program under way at this time is for engineers to be assigned to amphibian battalions. Men must have had experience in the operation of small boats. Appointments in all grades, up to and including colonels, will be considered; 1,000 officer personnel will be required, of which 250 have already been recruited.

The Engineer Corps is looking to the newly created Army Specialist Corps for much of its routine operation work, and openings will be filled through that Corps. As an example, practically all the Post Utilities operation will be handled by men appointed from the Army Specialist Corps. As previously mentioned, officer appointments in the Engineer Corps will be far fewer than heretofore.

Marine Corps appointments in the Engineer section are about filled. New age limitations have been set up as follows:

Second lieutenants	age 30 and under
First lieutenants	age 30–40
Captains	age 40–50
Other grades	above 50

Appointments in the Civil Engineer Corps of the Navy are still progressing at a moderate rate. The need at this time is for officers in the lieutenant classification, both junior and senior grade. An ample supply of ensigns is available, as well as the higher grades. Lieutenants, junior grade, are nominally appointed from ages 30 to 35; lieutenants, senior grade, from 35–40.

In all branches of the service, much greater restriction has been placed on appointments to grades higher than captain. The Army Specialist Corps (see July issue, page 363) is just now beginning to come of age. As the war continues, it is likely that this Corps will reach rather large proportions, and many of our members may find themselves serving in it.

POST-WAR PLANNING

The subject of post-war planning has been up and down in popularity for the past twelve months. The bill sponsored by the National Resources Planning Board, known as the Beiter Bill, HR 5638, identical with S. 1617, was decisively defeated in the House last spring.

House Joint Resolution No. 291, on post-war planning, known as the Voorhis Resolution, was reported out to the House calendar, where it remains at the present time. The purpose of this Resolution is to set up a thirty-man commission, to be appointed by the President, to study the subject of post-war planning. The objectives of the Resolution are proper. The Resolution specifies the appointment of "an outstanding industrial engineer," apparently the only engineer in the group of thirty.

The attention of the Labor Committee has been called to the fact that one of the vital elements of any post-war program will be consideration of an extensive program of public works, and that any such program must involve a great number of civil engineers—hence the desirability of having a civil engineer appointed to such a committee. The only way that this can be achieved will be for some Representative to propose such an addition from the floor of the House, in the hope that it may be added at that time. The Resolution yet remains to run the gauntlet of the Senate, where it may be changed at will.

The Voorhis Resolution has been publicly endorsed by the press and numerous agencies, including outstanding religious organizations. However, the time seems not yet suitable to begin an active campaign for post-war planning legislation.

WAR PRODUCTION BOARD

Affairs of the War Production Board have been in a state of flux for some weeks as a result of a conflict of opinions and purposes between the civilian element (War Production Board) and the military (Army-Navy Munitions Board). In the first week of July, Donald Nelson, chairman of the War Production Board, announced a reorganization which was, in effect, a shuffling of some of the key officials. On the surface, it would appear that the civilian element succeeded in carrying its points. However, the matter is far from amicably adjusted, and further shake-ups and conflicts of interest are sure to follow.

War Production Board activities have had the effect of great curtailment in civil construction. This materially affects the civil engineer and there is little likelihood of any improvement, except perhaps in the field of defense housing.

SELECTIVE SERVICE

Selective Service continues to draw considerable numbers of men into the armed services. New Selective Service rules have recently been issued which place civil engineers and civil engineering students on the preferred list, although injustices and inequalities are bound to appear in the mobilization of such an enormous number of men.

BOARD OF ECONOMIC WARFARE

Some time ago, the Board of Economic Warfare was created under the directorship of Vice-President Henry A. Wallace. One of the objectives directly affecting civil engineers is the preparation of plans for the reoccupation of countries presently occupied by the Axis, if and when the Axis armies are ejected. Essentially, the plan is that immediately upon reoccupation of the countries, the areas will be under military control, which will operate on the theory of transferring control to the Board of Economic Warfare as soon as military policy permits.

A part of the work of the Board of Economic Warfare will be to dispatch qualified civil engineers and contractors to the countries in question for the purpose of rehabilitating the public works of those countries. This will involve all of the fields of public works from power plants to public health. It is likely that any such program would involve a semi-military set-up. Officials of the Board of Economic Warfare have indicated their desire to have the active participation of the American Society of Civil Engineers in the cataloguing and supplying of qualified engineers to fit into the program.

CONTRACT RE-NEGOTIATION

In the spring, the question of excess-profits and profits-recapture legislation was quite active in Congress. Efforts were then being made to pass a flat limitation on profits for war contracts. Conservative elements were successful in defeating any such move and, as a result, compromise legislation developed which provides for re-negotiation of all contracts by the Secretaries of War and Navy and the Chairman of the Maritime Commission. Briefly, the Secretaries and Chairman of the Maritime Commission were empowered to appoint price adjustment boards, which, subject to the review of the Department heads, are to re-negotiate with contractors on whose contracts excessive profits are suspected.

By far the greater number of contractors involved are the suppliers of material and equipment of war. Nevertheless, civil engineers and architects engaged in defense work come under the bill and will be subject to its operation. However, they are in somewhat of a preferred position, their work being so different from that of the mass production of war materials.

Those of the engineering profession, operating under corporate structures, will feel a heavy blow from the 90% recapture of excess profits. If it has not already been done, it would be well to have legal counsel review every financial set-up in the light of the new tax program. Individuals and partnerships will find their income tax almost doubled if the present rates stand, which is probable.

The War Department is embarking upon a considerably greater program for the handling of re-negotiation of contracts than either of the other two agencies. While it is not officially announced or certain, it is likely that no contracts as of 1941 will come up for re-negotiation by that Board. It will confine itself to 1942 contracts believed to be obviously out of line.

In so far as possible, the War Department intends to conduct re-negotiation procedures on the basis of a fiscal year's operation; that is, contractors who have had several contracts in effect at one time will have their negotiations conducted so as to cover their entire operations for the year on all their contracts, and to give consideration to the balancing off of excessive profits on one contract against losses on another.

It will also be the policy of the War Department Board to assure all contractors that, in so far as possible, every questioned contract will be closed out finally not later than 90 days after the close of the fiscal year. In the event that a contractor has only one contract, or perhaps two, his case will be handled individually.

SPECIAL CONSIDERATION

It may be stated generally that civil engineers and their contracts with the Government for professional services, in so far as is known, are not the ones in which the Departments are particularly concerned. It may also be said that civil engineers and architects, as well as defense contractors working for the Army Engineer Corps, have been placed in a somewhat preferred category, with special rules for handling questioned cases, at the direct request of the Engineer Corps.

First Minneapolis Meeting Held 59 Years Ago

AS HE WELCOMED the Society to Minneapolis in July, President George C. Priester of the Engineers' Club of Minneapolis called attention to the fact that twice previously Minneapolis and St. Paul had been hosts to the Society for annual meetings.

The first meeting following World War I was held in the Twin Cities in 1919, when about 300 members and guests enjoyed the program and excursions prepared by the Northwestern Association (now the Northwestern Section) of the Society. In 1883 the Society's Annual Convention lent impetus to the formation of the Engineers' Club of Minneapolis, as is evidenced by the following letter which was circulated before that meeting.

"*Minneapolis, April 30th, 1883*

"*Dear Sir:*

"You are respectfully invited to meet the Engineers of this city in the Board of Trade Room, in the City Hall, on Friday, May 4th, at 7:30 p.m. to consider the question of appointing a committee to join with those of the Board of Trade and Chamber of Commerce, in making preparations for the entertainment of the American Society of Civil Engineers in June.

"The subject of forming a local Engineers' Club will also be discussed.

(Signed) "ANDREW RINKER
City Engineer
"Wm. A. Pike
"E. T. Abbott"

Open Forum on "Engineering Relations and Conduct"

CODES OF CONDUCT or ethics are of necessity more or less general in character and each covers a considerable variety of conditions. Usually they aim to establish principles and leave to the individual the solution of particular situations in the light of his own judgment and moral sensitiveness.

Because judgments may differ, the open discussion of particular circumstances in the light of ethical practice should prove enlightening. It is thought, therefore, that answers to specific questions will be of considerable value, especially to engineering students and young engineers. They should arouse interest and stimulate discussion by both younger and older members.

Among Society members no one has shown a greater interest in matters of professional conduct than Daniel W. Mead, Honorary Member. After negotiations with Dr. Mead, the Society's Committee on Publications has authorized a new department in CIVIL ENGINEERING to meet this need of discussing professional relations. It has been fortunate, also, in securing the assent of Dr. Mead to conduct this department. Dr. Mead will not only propound questions, but will receive answers and suggestions for other questions. He will also give his own interpretation of proper conduct in the circumstances propounded. To illustrate, Dr. Mead's first question and his answer are given here, as follows:

QUESTION 1: *Should an engineer or inspector accept minor favors, common among friends, from a contractor or superintendent of construction, such as cigars, theater tickets, and so forth?*

ANSWER 1: Such favors should be avoided, if possible without offense. However, unless this is done with finesse and caution it is apt to give offense and to engender such resentment that the cure may be worse than the ill. Frequently the acceptance of such minor courtesies seems desirable. If accepted, they should be returned in kind and the balance, if any, should be on the side of favors from the engineer or inspector. Do not leave yourself under obligation to anyone, especially not to a contractor whose work is under your supervision.

* * * *

Future questions will be propounded, one each month, and Dr. Mead's comments and answers will be given in the second month following. This will allow approximately five weeks for consideration and for correspondence by interested members. Answers or other suggestions are to be sent to the Editor at Headquarters, 33 West 39th Street, for transmittal to Dr. Mead.

Under this schedule Question 2 will be open for discussion until October 5, with summation and comment on it by Dr. Mead in the November number. A separate position for this department will be allocated adjacent to "Our Readers Say," of which it seems logically a part. All members are invited to participate in the written discussion of

QUESTION 2: *A senior engineering student had signed up with a company of good standing about three months before graduation. After spending considerable time in obtaining further information concerning the work available and the general nature of the particular job he had accepted, he found that the thing he would like best to do was not offered by this company. Would he be justified in asking for a release? Must he take this first job if he is positive that he is making a mistake? What would be the best thing to do in a case like this?*

"union" of those who will sign up promptly for only a nominal

sisted of only employees, and looked out for the

Employment Conditions Among Civil Engineers

Especially as Related to Collective Bargaining

By HOWARD F. PECKWORTH, M. AM. SOC. C.E.
ASSISTANT TO THE SECRETARY OF THE SOCIETY

Since March 1, Mr. Peckworth has been devoting his entire time to a special assignment of the Board of Direction dealing with engineering employment. This is in continuation of the work formerly done by his predecessor, Allen P. Richmond, Jr., M. Am. Soc. C.E., which resulted in constructive improvement in economic conditions in the state highway departments of Arizona, Nevada, and Nebraska, as previously explained at length in "Civil Engineering." The notes here abstracted have been taken from a longer report to the Board of Direction covering observations and inquiries related to collective bargaining, made during about 16,000 miles of travel to various sections of the country.

THE INDIVIDUAL CITIZEN seeking improvement in a democratic form of government must join with others having the same purpose. Recent legislation in the United States has greatly increased and facilitated the possibilities of group action. Under this legislation unions have grown strong, especially those affiliated with organized labor. Because so many engineers are employees needing group strength, they are aware of this trend toward grouping, collective bargaining, and unions. They are looking, therefore, for organizations which, functioning as pressure groups, will protect them from affiliation with organized labor and at the same time actively promote their economic interests.

One answer has been the reorganized State Engineering Society, but this has not been proved by a test case. Another answer may be more active interest by the already established and respected national engineering societies in the various conditions of employment of engineers; in the education of their own members in the legal and economic elements of collective bargaining; in recognition of the fact that young engineers and those in the subprofessional group are in need of special consideration; and in providing advice and help where there are acute employment difficulties. Some of the considerations leading to these conclusions will be developed in this report.

As soon as this study was started it became evident that an understanding of recent legislation dealing with employment conditions was of primary importance. In order to keep our members abreast of these laws, a series of articles has been run in CIVIL ENGINEERING, starting with the one by General Fleming in the June 1941 issue, and continuing with that by L. Metcalfe Walling, in the June 1942 issue. [It includes also that by Dr. Millis, chairman of the National Labor Relations Board, in this issue.—Ed.]

These legislative enactments were written to favor employees and are the outgrowth of definite conditions where employees were discriminated against unfairly. They deal specifically with minimum wages, maximum hours of work, and the rights of employees to band together for the purpose of bargaining with employers. Labor unions were organized primarily for the purpose of collective bargaining. The result is a great impetus to the growth and activities of labor unions and organized labor.

"Organized labor" now has great political strength. Its influence is enormous and must be reckoned with. It early recognized the power attained through pressure. Its field of activity has been, until recently, the manual trades and skills. However, with the preferentials accorded groupings of employees by the Wage-Hour Law, the Wagner Act, and other recent legislation, organized labor has sought to organize non-manual workers, technicians, and professional men.

TECHNICAL UNIONS

The organized labor groups working directly in the field of the engineer are the F.A.E.C.T. of the C.I.O. (Federation of Architects, Engineers, Chemists, and Technicians) and the I.F.T.E.A. and D.U. of the A.F. of L. (International Federation of Technical Engineers', Architects', and Draftsmen's Unions). These are the largest technical groups affiliated with organized labor, although there are other large independent unions containing many engineers, such as the N.F.F.E. (National Federation of Federal Employees).

These technical unions affiliated with organized labor have had their greatest success, thus far, when they have had the protection of the Federal Government. Examples of this are the large shipbuilding projects, certain of the airplane and war plants, and some of the governmental bureaus in Washington. Also, where municipal governments have been sympathetic to labor, technical unions have flourished. Actual cases of engineers losing their jobs because they refused to join organized labor are relatively few, but there have been numerous cases where their jobs have been threatened.

ATTITUDE OF ENGINEERS

Except in cases of unfair discrimination, approval, in the abstract, of unions by civil engineers is to be found primarily among young men with surveying, drafting, and computing jobs. Older men with jobs of inconspicuous responsibility, who for some reason have not made a success in life and have acquired an inferiority complex which leads them to feel that they will never rise far in the salary scale, swell the number. It is from these two types that union organizers secure the original founders of local unions.

A third type of engineer, who generally speaking would not himself join a union, is one who has achieved a really moderately satisfactory position as an employee in a somewhat sheltered or assured position, and who, believing he is thinking broadly, expresses himself as in favor of unions as the only medium through which the status of the profession can be improved. None of this type would adhere to their present attitudes, in all probability, if they were fully aware of the limitations, as well as the privileges, accruing to union members.

In general, engineers are averse to the use of the pressures which are the weapons of the unions. Those engineers who have had the advantage of advanced training, in engineering schools or under skilled and considerate supervisors, look upon their profession as a vocation founded upon specialized educational training and calling for honest thinking and fair play. However, even these cannot fail to be aware of the social significance that is now being accorded pressure groupings, or of the mandatory features of recent legislation.

Young engineers, especially, and those who recognize themselves as relative failures, tend to reach the conclusion that they must affiliate themselves with an organization that will fight for them. The suggestion has been made that the Society should set itself up as the bargaining group for all the civil engineers of the country. It is not realized that Society membership consists of both "employees" and "employers" and also those whom the decisions of the National Labor Relations Board (N.L.R.B.) and the courts have defined as being in "supervisory" positions, and as such not eligible to be members of an employee bargaining group. Another suggestion is that the Society join forces with the technical unions and thus, in behalf of civil engineers as a whole, gain the strength and influence of organized labor as an ally. Here there is the question whether the fundamental interests of the trades of which organized labor is composed and those of the engineers who direct the work performed by those trades, are at all common.

It appears that neither the Society nor any other national organization of engineers, except as its members be solely employees in the lower ranks of the profession, can affiliate, under the laws as they stand and are interpreted today, with organized labor.

BALANCE OF VALUES

It is well that the tangible advantages and disadvantages of affiliation by an engineer with a union be understood. The tactics pursued usually by a labor organizer is to discover, first, some malcontents in the lower ranks of an engineering organization. To these he expounds benefits that the union will secure for them. Usually, but not necessarily, the benefit he promises relates to pay, but it may relate to some other condition of employment. Usually he selects matters which the employer would be quite ready to rectify if they were brought to his attention and found practicable.

The second step is usually the holding of a social gathering to which the first converts invite others deemed susceptible. If all goes well the organizer addresses the gathering, which turns into a

"union" of those who will sign up promptly for only a nominal initiation fee, say $3.00, and nominal dues, say $1.50 per month, it being understood that for those joining after a week's, or two weeks' time—that is, when the "local" is really formed—the initiation fee will of course be very much higher.

The next step is for the organizer to serve oral notice on the employer that a local has been formed; that this local represents a majority (of a certain group although usually not a majority of the whole engineering group—it is not desired to wait for that) and that certain claims, usually modest, must be met. By presenting the matter in this way he keeps the employer from exercising his right to call for a vote of all of his employees eligible to membership to determine if they desire the newly formed "union" to be their "bargaining" agency. Usually the modest claims are such that the employer may comply and the union has won its first victory, which it uses to increase its membership and its initiation fee and dues. Thereafter the pressure is on—both on the employer, for larger benefits, and on the unorganized employees, to join.

However, some practical details complicate matters on a job for the Government. The Government has a contract with the employing engineer. Some demand is made with which the employer cannot comply within the terms of his contract. The Government's representative is then asked to break the contract in this particular. He refuses even though the demand may be reasonable and both he and the employing engineer are sympathetically inclined to grant it.

Various proposals are made by the representative of the union. The Government's representative can declare the job an "open shop" until such time as it is proved that the bargaining group represents the whole group. The Government's representative can then declare that the engineers joining with organized labor are subject to all provisions applicable to trade unions—pay for only days and hours worked, no accumulated vacation days with pay, termination of employment without notice, no provisions for living quarters or transportation, limited commissary privileges, and no participation whatsoever in management.

Emphasis on Professional Matters

IN this issue of CIVIL ENGINEERING, Society and professional interests loom large. Notable items include:

	Page No.
War service questionnaire	529
Reports on official Society activities:	
Employment	527
Washington, D. C.	525
Board of Direction meeting	522
Nominations for Board of Direction	530
Papers from Society Meetings:	
President Black on Society's War Effort	507
Ralph Budd on Transportation for Defense	503
Colonel Loper on Army Surveys	509
National Labor Relations Act, by Dr. Millis	487
Forum on Engineering Relations, by Dr. Mead	526
Advance notice, Niagara Falls Society Meeting	521

COUNTER UNIONS

A sincere appraisal of the attitude of engineers at this time is that they desire to resist unionization by present "organized labor." However, after a union has become established in accordance with the law, it is very difficult to do anything to hinder its growth or to escape pressure to join it. The law is so comprehensive that almost any counter move is illegal.

One possible way is to form an independent unaffiliated union on the grounds that the Wagner Act states that employees can join together for bargaining purposes but does not state that employees must become members of organized labor. Nor does it permit an employee to have two bargaining agents. Even in cases where an employee belongs to two bargaining agencies, it is the N.L.R.B. that decides to which he shall adhere.

A few years ago, in the State of Iowa, business agents of organized labor made a concerted effort to unionize all the engineers in the state. They started with the Highway Department and with the lowest paid members such as the laborers, axmen, and chainmen in the engineering field parties. Continuing up the scale they finally had district engineers in the union. At the request of engineers about to be involved and not desirous of joining in the movement, the Iowa Engineering Society took steps to counteract this union activity. The constitution was revised so that membership might be in either of two groups. One group, the technical group, consisted of both employers and employees; the other group, the professional group, or Professional Division, as it was called, consisted of only employees, and looked out for the interests of the employee engineer in the State of Iowa. This Professional Division consisted of only employees in order that it might fall within the provisions of the Wagner Act, which allows only employees to belong to a bargaining group. The personal requirements for membership in the Professional Division were lowered. The reasons for this were two-fold. Union activity gets started quickest among subprofessional employees, and in a pressure group there is strength in numbers. It is easy to see that subprofessional employees are susceptible to union activity because they previously have had no association experiences, usually are not well acquainted with each other, and do not know where to look among themselves for leaders. However, in Iowa they turned to an already formed organization which would permit its requirements to be lowered so that subprofessional men might become members.

This Professional Division of the Iowa Engineering Society assumed the bargaining rights for all the engineers in the state. In doing this it followed union tactics. A union will get a foothold by forming a small group and declaring itself the sole bargaining agent. It will then assume that it has the majority, and the bargaining rights for all the other employees in the group.

In Iowa a test case was inaugurated when a member of the Professional Division had pressure put upon him to join the union. The secretary of the Professional Division served notice in writing on the business agent of the union that this man, being a member of a duly organized bargaining group for all the engineers in the state, had no need, within the province of the law, to join another bargaining group. Union activity among engineers in Iowa ceased.

It is not to be assumed at this time that a procedure such as that of the Iowa Engineering Society, by the formation of a Professional Division, will be necessarily judged by the N.L.R.B. to be an adequate bargaining agency. However, if a really representative group of affected employees in considerable number show themselves earnestly desirous of resisting affiliation with organized labor, particularly if assisted sympathetically by an organization of other older and influential employees, not themselves directly affected, organized labor will probably desist, not wishing to make a test of the matter.

It must be borne in mind also, that unaffiliated independent unions must not be "company" unions. The "company" union is elaborately defined by test cases and it is worthless except as a social or academic group.

[As a practical matter, the Board desired that the Society should be of immediate assistance in all cases where employees or employers request help with their problems of collective action regarding working conditions. Accordingly the Board authorized that a staff member be sent to the scene of the difficulty in order that he use his best efforts to bring about remedial measures. Four large construction projects have been visited recently. One such case resulted from the request of a Junior of the Society that aid be given with respect to salary misunderstandings or possible injustices. The project was visited, all parties interested were consulted, and remedial measures were indicated even to the extent of following recommendations through by visiting the responsible authorities in Washington. Similar procedure was followed with respect to the other visits, as the need of it became evident in one manner or another. These trips and this study have already resulted in the accumulation of experience and knowledge about employer-employee relationships. This knowledge is now available to every member whether he be an employee in a junior capacity, an employee in a supervisory position, or an employer.—Ed.]

Society's War Registry

Questionnaire Shows Many and Varied Activities of Members

DURING August the Society has conducted a most interesting survey by mail, relative to the war activities of its members. On the sixth of the month the last of approximately 17,700 postcard questionnaires left Headquarters asking for prompt reply to three groups of queries. Twelve days later, on August 18, replies to the number of 10,301 were analyzed with respect to their major characteristics.

Question 1 had to do with those in the armed forces of the United States and allied countries. Only a very few of those who are in the armed forces and now outside the United States replied. Doubtless there are several reasons for this. Not sufficient time has elapsed for the questionnaires to reach them or for them to reply. Possibly the censor will not permit response—that difficulty was expected. In several cases their relatives have indicated their general location as "overseas" or "in the Navy." One father reported his son as having been in the Army in the Philippines, with no knowledge of him since Bataan and Corregidor.

Without applying any factor, or guess, as to the lack of answers from those in the armed services over or on the seas, 14% of the replies show Society members to be in the Army or Navy. If that percentage is representative of the total membership, 2,510 of the Society's members are in Army or Navy uniforms—1,883 with the Army and 627 with the Navy. Of those in service, 94% have commissions.

Question 2 had to do with those members who on or about August 1 were engaged on war projects or industries. In all, 45% report themselves thus engaged, most of them 100% of their time.

It is fascinating to note the various kinds of war projects making use of civil engineers. By far the greater number are engaged in the construction of military, not industrial, facilities. A list of all the various types of projects would be long; shipyards, drydocks, naval bases, ports and warehouses, hospitals, air fields, camps or cantonments, depots, and the Alaska Highway predominate. The smaller proportion are engaged on the construction for, or operation of, war industries such as power plants, ordnance plants, and the many other kinds of industrial processes.

It is evident that as a type these men are doing just what they are most capable of doing. Positions range from chief engineer in charge of a project, or superintendent of construction, to design, surveying, and layout.

Replies to Question 3, regarding official activities growing out of the war, are surprising as to the extensive list represented. Only 13% of the replies showed a "Yes" answer to this question, and of these some replies indicated activity in lines other than those that might be deemed official. Some confusion as to how this question was to be answered was to be expected. Replies ranged from "Gas Rationing Board," or "Red Cross" to "War Production Board," or even to the Office of Price Administration. Replies to Question 3, and also to Question 2, were in several cases marked "Yes—Confidential."

On 28% of the replies the answer was "No" to all three questions. No attempt has been made to classify these men with respect to what they are doing, although most of the cards would permit of a fair analysis.

Complete analysis as to whether more of the older, or more of the younger, members of the Society are engaged in war efforts has not been attempted. But it is remarkable that in this fairly large sampling Juniors, Associate Members, and Members replied in very close proportion to the number in each grade. Relatively, Juniors are behind 10% and Members are ahead 10%; Associate Members are in direct proportion.

It appears, therefore, that the conclusions drawn from this substantial response are probably reasonably accurate for the entire membership, with one exception. The percentage of those who are in the armed services and are now "somewhere" will unquestionably show an increase when further replies are received, say, a month hence. Even then it is probable that the total of those in uniform will never be known precisely.

Response to this whole questionnaire has been most gratifying to date. Those who have not returned their cards—in sealed envelopes, passed by the censor, if advisable, or by relatives or business associates—are urged to do so promptly in order that as complete a survey as possible may result.

Early History of Providence Section

RECENTLY the Society has received a brief historical write-up covering "The First Ten Years of the Providence Section." Correspondence and records were examined to collect the necessary data. The result is a useful record, not only for the Section files, but for deposit at Headquarters.

Although the Providence Section was not one of the first to be formed, it is already more than twenty years old. It occurred to some of the members that unless the interesting features of its early days were collected, its history might be lost entirely. Officers come and go; many move from the area. It happened that the corporate members who signed the original petition were in general a group of older men, hence, nine out of the eighteen have since passed away. This indicates the difficulty of collecting data on past Society events. It also emphasizes that other Sections might well devote the necessary time and effort to insure that their records are complete. The Providence Section has done a worthwhile service.

The present history was undertaken by Harold E. Miller, Assoc. M. Am. Soc. C.E., formerly chairman of the Section and long active in its affairs.

Suggestions to "Civil Engineering" Authors

CIVIL ENGINEERING was created in 1930 by the Committee on Publications to provide a publication medium for technical papers of a descriptive or pictorial character, free from highly mathematical treatment, and deemed to be of permanent interest to the civil engineering profession. Its value is entirely dependent upon the contributions of engineers interested in the development of new techniques and new products, and the Society therefore welcomes these papers and discussions. It is against the policy of the Society to remunerate authors for their work.

So that there may be a certain amount of uniformity in the preparation of manuscripts, several suggestions to authors have been formulated. To aid them in presenting their work, these are here repeated:

1. All manuscripts should be typewritten and double spaced.
2. The original copy of the manuscript should be submitted on letter paper rather than on thin manifold paper. Covers need not be used.
3. A generous number of illustrations of good reproductive value should be submitted. Diagrams, curves, and tables should be referred to in the text and should be numbered. Titles should be attached to all illustrations. Blueprinted tables should not be used because of the difficulty of reproduction.
4. The maximum length possible to publish is about 3,500 words of text. The short description of new and better construction or design procedures, or of newly developed equipment (not commercialized) creates widest interest in the Engineers' Notebook section. Here a length of 1,500 words is the maximum.
5. Papers must be presented for the exclusive use of CIVIL ENGINEERING, and upon acceptance they become the property of the Society.

Disposition of "Civil Engineering" Cuts

AUTHORS of papers in Vol. 11 (1941) "Civil Engineering," or other members who have further use for the engraving plates used therein, must send their requests to Society Headquarters before September 15. A Government order requiring disposal of obsolete engraving plates not more than a year after their use in the Society's publications will aid in recovering strategic metals such as aluminum, antimony, chromium, copper, lead, nickel, and zinc.

Since the Government order states that a plate shall not be deemed obsolete if there is an assured future use for it, Society publications are able to extend this additional service to members. The previous rule holds that authors have first choice of cuts, and thereafter other interested members.

In the case of all engravings that have appeared since January 1942, it will be necessary to make requests for them not later than ten months after the publication date. Thereafter plates will be scrapped and the metal salvaged. This is a new regulation that will cover all future disposition of cuts.

Tellers Report on First Ballot for Official Nominees

To the Secretary *August 3, 1942*
American Society of Civil Engineers

The tellers appointed to canvass the First Ballot for Official Nominees report as follows:

For Vice-President, Zone II		
Edgar M. Hastings	330	
Scattering	67	
Void	78	
Blank	9	
Total	484	
For Vice-President, Zone III		
Thomas R. Agg	153	
George E. Barnes	148	
W. W. Horner	136	
Charles Keller	76	
Clyde T. Morris	37	
Scattering	88	
Void	63	
Total	701	
For Director, District 1 (Two to be elected)		
R. E. Bakenhus	220	
Dean G. Edwards	214	
Scattering	69	
Void	119	
Total	622	
For Director, District 2		
Albert Haertlein	50	
Charles B. Breed	29	
Scattering	18	
Void	17	
Total	114	
For Director, District 6		
Charles F. Goodrich	68	
Scattering	7	
Void	7	
Blank	2	
Total	84	
For Director, District 10		
Nathan W. Dougherty	186	
Scattering	9	
Void	11	
Blank	2	
Total	208	
For Director, District 13		
Fred C. Scobey	90	
H. H. Hall	31	
George D. Whittle	22	
Scattering	12	
Void	29	
Total	184	
Ballots canvassed		1,794
Ballots withheld from canvass		
From members in arrears of dues	73	
Without signature	13	
Illegal	4	90
Total number of ballots received		1,884

Respectfully submitted,
HOWARD HOLBROOK, *Chairman*

James M. Webster	Bertram J. Ahearn	William H. Dieck
James McKeegan	Milton Brumer	Bernard Gaber
George L. Freeman	George T. Larson	Eugene H. Paddock
Joseph D. Lewin	Robert E. White	Daniel J. Barrows
Frederick W. Ockert	Joseph Farhi	E. N. Whitney
Harry W. Stuber	Arthur S. Pearson	I. Rosov

Tellers

Appointments of Society Representatives

GEORGE W. BURPEE, M. Am. Soc. C.E., has been reappointed one of the Society's representatives on the Engineers' Council for Professional Development for the three-year term, October 1942 to October 1945.

FREDERICK H. FOWLER, Past-President Am. Soc. C.E., has been appointed to represent the Society on the Division of Engineering and Industrial Research of the National Research Council for a three-year term beginning in June 1942.

News of Local Sections

Scheduled Meetings

COLORADO SECTION—Dinner meeting at the University Club on September 14, at 6:30 p.m.

DAYTON SECTION—Luncheon meeting at the Engineers' Club on September 14, at 12:15 p.m.

SACRAMENTO SECTION—Regular luncheon meetings at the Elks Club every Tuesday at 12:15 p.m.

ST. LOUIS SECTION—Luncheon meeting at the York Hotel on September 28, at 12:15 p.m.

SEATTLE SECTION—Dinner meeting at the Engineers' Club on September 28, at 6:30 p.m.

TEXAS SECTION—Luncheon meeting of the Dallas Branch at the Dallas Athletic Club on September 7, at 12:10 p.m.

WEST VIRGINIA SECTION—Two-day meeting to be held in Charleston, W.Va., on September 25 and 26, at the same time as the annual convention of the West Virginia Society of Professional Engineers.

Recent Activities

GEORGIA SECTION

The July meeting of the Section took the form of a luncheon on the 13th. There was no formal program, but discussion during lunch centered about plans to help the Student Chapter at the Georgia School of Technology obtain an engineer unit in the R.O.T.C. On motion of Professor Black, the president was instructed to appoint a committee to work on the project.

LOUISIANA SECTION

The Louisiana Section reports an interesting and unusual meeting held aboard the yacht *McCloskey*, which was loaned to the group through the courtesy of the Board of Commissioners of the Port of New Orleans. The yacht left the foot of Canal Street at 8 a.m. and proceeded down the river to Chalmette. On the return trip it entered the Industrial Canal, passing through the locks and continuing as far as U.S. Highway 90. During the trip Marcel Garsaud, general manager of the Board of Commissioners, addressed the group on the subject of the various engineering projects being constructed along the banks of the Industrial Canal. Breakfast was served en route through the courtesy of the Board.

NEBRASKA SECTION

On June 3 the Nebraska Section celebrated its second annual Ladies' Night with a dinner meeting held in Omaha. A film, entitled "Winning Your Wings," comprised the technical program. This was shown by Sergeant Redfern, of the U.S. Recruiting Service.

PITTSBURGH SECTION

At the May dinner meeting of the Pittsburgh Section, I. Lamont Hughes discussed the activities of the Pennsylvania State Department of Highways. Mr. Hughes, who is secretary of highways for the department, called attention to the rapid growth of the state highway system since 1912, when the system was established. At the present time, approximately 40,000 miles of roads are included in the system. This mileage constitutes 41% of all the roads and streets in the state and is the largest state highway system in the

United States. "The war has changed all of our improvement plans," Mr. Hughes stated. "Anticipating defense and war requirements of essential and strategic materials, we modified the designs of our highways and bridges to eliminate entirely steel reinforcing in concrete pavements, and reduced to the minimum the steel requirements in bridges by designing gravity abutments and piers and reverting to plain concrete and masonry arches wherever possible. We have also designed temporary wooden bridge floors and superstructures where this was practical."

Certain parts of the highway system have been designated of strategic military importance by the Federal Government, and all available funds are now allocated to the improvement of these portions. ". . . any highway, which will meet the requirements of modern commercial traffic, will more than meet military requirements," Mr. Hughes concluded.

SACRAMENTO SECTION

Interesting and varied programs featured the June meetings of the Sacramento Section. A symposium on "Writing Applied to Engineering" was enjoyed on one of these occasions, the speakers being Joseph M. Kane, assistant office engineer for the State Division of Highways, and John H. Howe, editor of *California Highways and Public Works*. The former discussed the technical aspects of engineering expression, covering the writing of reports and specifications, while Mr. Howe approached the subject from the vantage point of writing to reach the layman. The speakers at other luncheons included Howard L. Stilley, assistant Western sales manager of Le Tourneau Company; R. Robinson Rowe, associate bridge engineer for the California State Department of Public Works; and Terrell McKenzie, of the Public Works Reserve. On June 30 the Juniors put on a surprise program. They divided the audience into two groups, had each group select a representative, and then gave the representatives three minutes to solve quaint mathematical problems. The senior members surprised themselves by not batting very high, none of them staying on the platform for more than two questions.

ST. LOUIS SECTION

On May 25 the St. Louis Section joined the Washington University Student Chapter for a dinner meeting on the university campus. Fathers of the senior-class students had been invited to attend, as each senior gave a brief talk describing his thesis project. The subjects ranged from "Stabilization of Soils by the Addition of Cement" to "Photoelastic Analysis of Bending Stresses in Thin Plates." Later the meeting adjourned to the laboratories, where each of the students gave a more detailed explanation of his work and Professor Brust explained the operation of the new testing machines recently installed. The Section's awards of Junior membership in the Society go to William M. Harting and Henry M. Reitz, of Washington University.

SAN DIEGO SECTION

The principal speaker at the June meeting of the San Diego Section was A. M. Rawn, Director of the Society, who discussed "The Structure of the Society." Mr. Rawn pointed out that the pattern of the Society is world-wide and commands respect as an engineering organization. It is a guide to sound engineering and maintains the engineer's faith in his profession. The Local Section, he emphasized, "is the strongest link in the Society," for it is in the Section that problems are first worked out.

SAN FRANCISCO SECTION

A regular bi-monthly meeting of the Section was held on June 16, with 85 members and guests attending the dinner and a few more coming in for the meeting later. The speaker and guest of honor was E. P. Goodrich, Director of the Society and New York consultant. In his talk—on "Scientific Approaches to City Planning"—Mr. Goodrich outlined methods employed in determining the distribution of population and the growth of communities in connection with city planning and described adequate housing development, based upon the most desirable health, social, and transportation requirements. His talk was illustrated with blackboard sketches and lantern slides.

At the May meeting of the Junior Forum the technical program consisted of talks by two members—Harvey F. Ludwig, junior civil engineer for the Western Regional Research Laboratory, and Edwin Epstein, junior engineer for the U.S. Engineer Office. The topic for general discussion was "Should Engineers and Skilled Labor Be Deferred from the Draft?"

SOUTH CAROLINA SECTION

The annual summer meeting of the Section—held in Columbia on June 26—consisted of a joint session with the South Carolina Society of Engineers. The speakers who appeared on the all-day program were the Hon. R. M. Jefferies, governor of South Carolina; C. J. Corliss, manager of the public section of the Association of American Railroads; Maj. G. Heyward Mahon, director of the South Carolina Council for National Defense; W. W. Dibble, assistant traffic engineer for the South Carolina State Highway Department; Prof. W. M. Bauer, of the University of South Carolina; and Gen. C. P. Summerall, U.S. Army, retired, and president of The Citadel (Military College of South Carolina).

TACOMA SECTION

On June 16 members of the Section met at the Fort Lewis Inn (on the Olympia-Tacoma Highway) for dinner and a technical session. A talk on the new coking plant being built in Tacoma for the Wilkeson Coal Company was given by C. H. Case, chemical engineer in charge of construction. Mr. Case discussed the modern design of the plant and the product and by-products derived during the coking process. He also described his experiences while engaged in similar installations in Japan, from which he returned shortly before the outbreak of the war. A general discussion followed his talk.

TENNESSEE VALLEY SECTION

On Saturday afternoon, June 20, members of the Knoxville Sub-Section met at Douglas Dam, a TVA project on the French Broad River above Knoxville, for an inspection trip and dinner. A number of members of the Tennessee Valley Engineers Association (composed of engineer employees of the TVA) also made the trip. The group walked around the cofferdam, viewing operations at close hand, and later went by automobile to one of the saddle dams. Following dinner at the Douglas Dam Cafeteria, there were two interesting talks on the project. First, James S. Lewis, construction superintendent, discussed "Construction Phases of Douglas Dam." The second speaker was Thomas F. Taylor, construction engineer, who talked on engineering phases of the project. Of particular interest was a description of the difficulties encountered in trying to stop the leakage of water through the cofferdam. The speaker at the July meeting was Charles W. Okey, principal civil engineer for the TVA. Mr. Okey gave a clear picture of the economic principles involved in the protection of the communities adjacent to the various TVA reservoirs.

TOLEDO SECTION

A number of students from the University of Toledo attended the May meeting of the Section. Kermit Eckert, winner of the Section's award for a student paper in the 1942 Daniel W. Mead competition, was introduced and read his paper. Following a brief talk by Delos M. Palmer, dean of the engineering school at the university, the group visited the university's various machine shops and laboratories. The shops are now working day and night training defense workers.

UTAH SECTION

Problems confronting the profession in the most effective utilization of engineering services in wartime were discussed at the June meeting of the Utah Section. The principal speaker was Thomas C. Adams, associate professor of civil engineering at the University of Utah. Dr. Adams cited considerable statistical information indicating that engineers and engineering talent should be conserved for the vital needs of war and defense. This is a war of production, he pointed out, contending that seventy-five professionally trained men will be required in industry for each one in the armed forces. In cases where professional men are inducted into the armed forces, he said, their abilities should be used where they will do the greatest good in the war effort.

On May 9 the members of the Section gathered for a special luncheon, at which Howard F. Peckworth discussed employment conditions in the country at large. A group discussion of local conditions concluded the technical program.

ITEMS OF INTEREST

About Engineers and Engineering

CIVIL ENGINEERING for October

HOUSING for the families of fifty thousand war workers has become the task of both federal and private agencies in Wichita, Kans. As the units have taken form throughout the city, the City Planning Commission has guided their location to fit best into the established city plan. Revisions in this plan were at times found unavoidable to secure economy of location, as explained in the article by P. L. Brockway, city engineer.

News of recent flood damage in northeastern Pennsylvania created headlines throughout the nation, yet little attention was given to the heroic crews of the highway departments that immediately set to work repairing the damage and reestablishing traffic facilities. John L. Herber, District Engineer of the Pennsylvania Department of Highways, will describe the erection of temporary structures and repair activities, as well as the organization of the work, in the forthcoming issue.

Underwater structures of harbor facilities require careful planning and often frequent inspection and repair. G. G. Greulich, of the Carnegie Illinois Steel Corporation, as a result of his investigations of the effects of destructive forces on steel piling, will recommend measures to protect such construction.

In another article, Charles R. Waters discusses the manufacture and maintenance of highway markers for economy and long life, as practiced at the Buffalo Office of the New York State Department of Public Works. The total cost of an engineering structure is too often forgotten in the desire to keep its first cost as low as possible. Considerable research on highway signs and markings that will resist destructive forces has been carried out by his office

Use of Low-Alloy Steels Urged

TO PRODUCE all the alloy steels vital to the war program it has become necessary to spread the active alloying elements as thin as possible without impairing the properties of the metal. American metallurgists have determined the effect of combinations of alloying agents and heat treatment to a degree that makes possible the widespread use of new low-alloy steels.

The American Society for Metals has issued a pamphlet, "National Emergency Steels," describing these materials and their properties in detail. In a letter accompanying it, Donald M. Nelson urges producers to become acquainted with these new steels and to commence immediately to use them, taking advantage of their more uniform properties and at the same time conserving vital alloying materials. Known as "NE-800" series and "4,000" or "Amola" series, hundreds of heats of these two series have been used and their performance checked to the entire satisfaction of the industry. Manganese, silicon, nickel, chromium, and molybdenum can possibly be thus spread to meet the demands of materials producers. The use of vanadium and tungsten is controlled by priority order.

Mr. Nelson states: "These national emergency steels are now available. The Army and Navy are specifying them whenever possible, and I am confident that all other users of alloy steels will contribute to the war effort by similarly making extensive use of them."

The pamphlet, "National Emergency Steels," may be obtained at 25 cents a copy from The American Society for Metals, 7301 Euclid Avenue, Cleveland, Ohio.

N. G. Neare's Column

Conducted by

R. ROBINSON ROWE, M. AM. SOC. C.E.

"IF MY July puzzle of the three tunnels to Tokyo teased many of you gentlemen for a few hours, you will be delighted to hear a report from my foreign correspondent, Alenfer de l'Axe. Proving the rapidity and precision of Axis espionage, the details were broadcast a few hours later with a seven-column spread in the Tokyo Free (sic) Press. The ensuing consternation exceeded that which followed the invasion by General Didlotz.

"Evacuation of the city started with the removal of Charlie Hirohito to his summer jail at Hayama. Cooler-headed Nipanzis argued that the tunnels were a Yankee bluff, but the stampede couldn't be stopped.

"Air scouts, inspired, looked at their maps. The tunnel lengths narrowed their search for our bases at Shangri La, Shangri Lo and Shangri Lum. Flying in calculated circles, they would soon spot the fresh mountains of spoil removed from the tunnels. They're flying in circles yet, because we outsmarted them.

"To destroy just such evidence, we located the portal for the 1,000-mile tunnel just above high tide on a deep bay, so that all tailings are cast into the sea. Like the ground hog, that leaves no mound to mark his burrow, we started the 2,000-mile tunnel at the middle, and are working two headings towards the ends. The 3,000-mile tunnel is a masterpiece of ingenuity on the part of our Sappers. Using 5,000,000 salvaged and reconditioned post holes, the Sappers welded them together end-to-end and are now ramming the line through the earth with just one jeep pushing at the end.

"All three tunnels will soon be ready. Who figured how to dispatch the three gravity projectiles so as to reach the objective simultaneously?"

"I'd release them in a salvo!" cried Cal Klater. "No matter how long the tunnel, the running time will be 42.22348 minutes."

"Do you really believe that, Cal? That the time would be the same for a tunnel one inch long as for a diametric one 7,918 miles long?"

"I do now, Professor, but not until after I had figured it three different ways. Incidentally, gravitational attraction within the hypothetical earth is proportional to distance from geocenter and the running time is $\pi\sqrt{R/g}$."

"Entirely right, Cal. Newton couldn't have done better. Now suppose Shangri La is due north of Tokyo, Shangri Lo is northeasterly in the Aleutian Islands and Shangri Lum is easterly in the Hawaiian Islands. Also suppose the salvo is fired to reach Tokyo at 7:00 a.m. next December 7. When will each of the bases hear the blast?"

"You mean that the tunnels will become speaking tubes, Noah. Can't we air-condition them?"

"Yes, let's say that the temperature is constant, at 20 C if you like."

(*Cal Klater is very complicated. He is or are Richard Jenney and F. G. Switzer, whose replies were postmarked alike to the minute. He is the anonymous A. Nuther Nutt, who cited an analogy in the pendulum with period independent of amplitude. He is or are Mat Matox (David E. Hughes) and Ann Othernut (J. Charles Rathbun), who expounded on the effects of the earth's rotation and orbitation, precession, nutation and solar and lunar tides, but agreed that these wouldn't vary much in the 42 minutes.*)

Thayer School Changes Name

DARTMOUTH COLLEGE is one of the early institutions to embark upon the teaching of engineering. This has been carried on in The Thayer School of Civil Engineering. Upon recommendation of the overseers of the school, and by action of the trustees of Dartmouth College, the name is now being changed to "The Thayer School of Engineering." Many Society members have been associated with the Thayer School as students or teachers. At present William P. Kimball, Assoc. M., is acting dean of the school.

For Those Who Have Resided Abroad

OF PRIME INTEREST to the U.S. Department of Commerce is information on the products, crops, or economic, industrial, and social conditions of foreign countries. The Government is in need of any such material that a person who has resided abroad can supply.

To gather this information, a form has been prepared by the Department of

Commerce which will be sent to anyone who desires to cooperate in furnishing special knowledge gained during foreign residence. There are no positions open in connection with this inquiry, but voluntary assistance is earnestly requested.

The forms for the confidential use of the U.S. Government may be obtained from Wayne C. Taylor, Acting Secretary of Commerce, Department of Commerce, Commercial Intelligence Unit, Washington, D.C.

Brief Notes

THE Twenty-Third Annual Meeting of the American Welding Society is to be held in Cleveland, Ohio, October 12–15. A wide variety of technical papers will be presented and discussed, including such pertinent subjects as war production, aircraft welding, welding of ordnance, and shipbuilding. The Hotel Cleveland will be the meeting headquarters.

* * * *

IOWA State College announces the publication of Bulletins 155 and 156 on the depreciation of group properties. The first of these may be obtained without charge from the Iowa Engineering Experiment Station at Ames, Iowa. The companion volume, Bulletin 156, consists entirely of tables of use in applying the principles developed. It is available at a charge of $3.

* * * *

A "GERMAN-ENGLISH Vocabulary of Soil Terms," compiled by H. B. Edwards, has recently been issued as Soil Mechanics Bulletin No. 15 of the U.S. Waterways Experiment Station. The foreword, by Gerard H. Matthes, M. Am. Soc. C.E., director of the Station and head engineer of the Mississippi River Commission, states that the primary purpose of this "Vocabulary" is to make available to students and research workers "a compact glossary of the more unusual and obscure terms found in modern German works dealing with soil mechanics—terms which are not usually found in general technical dictionaries." For copies apply to the Director, Engineering Experiment Station, Vicksburg, Miss.

* * * *

THE U.S. WEATHER Bureau has recently issued a booklet of *Maps of Seasonal Precipitation; Percentage of Normal by States; Fifty-Three Years, 1886–1938.* This also includes tables of normals and of the 10 wettest and 10 driest seasons and years. This pamphlet (numbered W. B. No. 1353) may be obtained from the U.S. Government Printing Office, Washington, D.C.

NEWS OF ENGINEERS

Personal Items About Society Members

G. W. SPAULDING has been promoted from the position of assistant chief engineer for the Pennsylvania Water and Power Company, Baltimore, Md., to that of superintendent of power. Other changes in the organization include the promotion of DONALD GUNN, formerly assistant to the chief engineer, to the position of chief engineer.

BURLESON GRAHAM, previously assistant traffic engineer for the City of Dallas, Tex., is now a private in the U.S. Army, 347 Engineers (GS). He is stationed at the Engineer Organization Center, Camp Claiborne, La.

STANLEY R. BIESACK, a lieutenant in the Construction Quartermaster Corps of the U.S. Army, has been transferred from Chattanooga, Tenn., to Buffalo, N.Y.

JAMES E. GODDARD has been promoted from the rank of captain in the Corps of Engineers, U.S. Army, to that of major.

EDWARD H. LESESNE is now a lieutenant in the U.S. Army, stationed at Duncan Field, San Antonio, Tex., where he is assistant to the Post Utilities Officer and the Utilities Transportation Officer. He was formerly in the Hydraulic Data Division of the TVA.

WILLIAM W. WANNAMAKER, JR., was recently promoted from the rank of lieutenant colonel, Corps of Engineers, U.S. Army, to that of colonel. Colonel Wanamaker is district engineer at Denison, Tex.

BARTON M. JONES has resigned as head planning engineer for the Tennessee Valley Authority at Knoxville, Tenn., in order to go to Peru as chief engineer on the construction of a hydroelectric power system recently authorized by that government. The project is in the Santa Valley about 200 miles north of Lima.

C. C. COYKENDALL has obtained a leave of absence from his duties as administration engineer for the Iowa State Highway Commission, in order to serve as field engineer for Lytle and Green Company, contractor for the north end of the Alaska highway.

GEORGE W. COX, who was recently promoted from the rank of lieutenant in the Corps of Engineers, U.S. Army, to that of captain, will be in charge of building a municipal airport at Beeville, Tex.

MELVIN D. WILLIAMS, district engineer for the Public Roads Administration at Juneau, Alaska, has been appointed a representative of the Federal Works Agency on the Alaska War Council.

THOMAS D. SHIELS is now a captain in the Army air forces, stationed at Lowry Field, Denver, Colo. Until lately he was field engineer for the Portland Cement Association, with headquarters at Abilene, Tex.

THEODORE S. BOGARDUS, formerly assistant city engineer of Meadville, Pa., has become connected with Havens and Emerson, Cleveland (Ohio) consultants.

C. W. SMEDBERG has been named North Carolina consultant to the Civilian Defense Board for the 4th Corps Area, with headquarters at Atlanta, Ga. He was previously city manager of Greensboro, N.C.

HAROLD H. SLATER, until lately assistant engineer in the County Engineer's Office at Wooster, Ohio, has been commissioned a captain in the field artillery and is stationed at Fort Knox, Ky.

EDWARD M. BEARDSLEE was recently appointed city manager of Deland, Fla. He was formerly senior draftsman for Hentz, Adler and Shutze, of Atlanta, Ga.

FRANCIS P. WITMER announces that he will discontinue his duties as director of the department of civil engineering at the University of Pennsylvania in order to resume professional practice at his former address, the office of HOWARD C. BAIRD, New York City consultant with offices at 95 Liberty Street.

F. C. DUGAN has been ordered to report to Fort Knox, Ky., for duty as a major in the Corps of Engineers. During his absence his position as chief engineer of the Kentucky State Department of Health will be filled by ROBERT R. HARRIS, who will have the title of acting chief engineer.

JACK SINGLETON, for the past fifteen years district engineer of the American Institute of Steel Construction, has been granted a leave of absence from that organization in order to serve as a major in the Corps of Engineers.

A. P. GREENSFELDER is again president of the Fruin-Colnon Contracting Company (St. Louis, Mo.), replacing JOSEPH E. VOLLMAR, who has been called into service as colonel in the Corps of Engineers, U.S. Army. Mr. Greensfelder will continue as chairman of the board.

TOM JOHNSON ALLEN, formerly chief engineer of the Linda Vista Housing Project, San Diego, Calif., has been commissioned a major in the Corps of Engineers, U.S. Army.

WALTER G. WILL, commander, U.S. Coast Guard, has been made chief of the Civil Engineering Section, Office of the District Coast Guard Officer, Ninth Naval District, Cleveland, Ohio. In this position he will succeed COMDR. F. P. DILLON, who has been transferred to Coast Guard headquarters in Washington, D.C. Commander Will was previously in the Northern Inspector's Office of the Coast Guard at Cleveland.

JOE W. JOHNSON was recently appointed assistant professor of mechanical engineering at the University of California, the appointment to be effective October 1. Mr. Johnson was formerly hydraulic

engineer for the Soil Conservation Service in Washington, D.C.

E. P. WIEDENHOEFER has been advanced from the position of assistant professor of civil engineering at the Michigan College of Mining and Technology to that of associate professor.

FRANCIS P. GILBERT, previously soil conservationist in charge of flood control surveys for the northeastern region of the U.S. Soil Conservation Service, with headquarters at Lancaster, Pa., is now senior architectural engineer at the Naval Advance Base Depot at Davisville, R.I.

WILLIAM E. STANLEY, who for the past year has been serving as chief of the sewerage and incineration unit in the Construction Division of the U.S. Corps of Engineers, in Washington, D.C., has accepted a commission as major in the Corps of Engineers.

SPENCER A. SNOOK recently severed his connection as bridge designer for the New Jersey State Highway Department in order to accept the position of office engineer with the Duffy Construction Corporation. He will be in charge of engineering work on the construction of an army-aid depot at Bellemead, N.J.

CLARENCE V. KNUDSEN is now a designer with the consulting engineering firm, Modjeski and Masters, with headquarters in Harrisburg, Pa. Until lately he was senior engineer in the Division of Design of the Nebraska Bureau of Roads and Irrigation.

LYNN PERRY has been granted an indefinite leave of absence from his duties as associate professor of civil engineering at Lafayette College in order to report for active duty as a lieutenant colonel in the Corps of Engineers, U.S. Army. For the present Colonel Perry is stationed at Camp Claiborne, La.

C. FRANK JOHNSON has been promoted from the position of senior engineer for the Commissioners of Sewerage of Louisville, Ky., to that of chief engineer, succeeding the late WOOLSEY M. CAYE as head of the engineering department. Mr. Johnson has been with the Commissioners of Sewerage for the past twelve years.

FRANKLIN W. FISH, JR., is now a major in the Corps of Engineers, U.S. Army. He was recently transferred from duty as area engineer in charge of Camp Beale at Marysville, Calif., to an assignment as post engineer at the Army Air Corps Replacement Training Center at Salt Lake City, Utah.

EDWARD H. ROCKWELL announces his retirement as director of the division of civil engineering at Lafayette College. He will be succeeded by WILLIAM S. LOHR, professor of civil engineering.

HUGH D. BARNES, for four years regional highway engineer of the Portland Cement Association and since September 1941 acting district engineer in charge of the Los Angeles office, has been appointed district engineer. He will direct the work of the Association in southern California, Arizona, and southeastern Nevada, and will have his headquarters in Los Angeles.

FRANK R. CULLATY was recently promoted from the position of junior engineer in the U.S. Engineer Office at Williamsport, Pa., to that of assistant engineer (civil).

N. B. HIGGINS has been elected president and a director of the Safe Harbor Water Power Corporation, Baltimore, Md., to fill the vacancy caused by the death of FREDERICK A. ALLNER. Mr. Higgins was previously chief engineer of the organization.

GEORGE GUY KELCEY is now assistant director of the Division of Local Transport of the Office of Defense Transportation, with headquarters in Washington, D.C. He was formerly president of Vehicular Parking, Ltd., Newark, N.J.

JACOB T. WANKMULLER has resigned as assistant sanitary engineer for the New York City Department of Health in order to accept a position as construction engineer for the Federal Works Agency. He has been assigned to the Chickahominey water supply for Langley Field, Fort Monroe, and the city of Newport News, Va.

B. F. VANDERVOORT, lieutenant colonel, Corps of Engineers, U.S. Army, has been transferred from Columbus, Ohio, where he was district engineer, to Cincinnati, where he will serve in a similar capacity.

C. H. WAINRIGHT has been commissioned a first lieutenant in the Corps of Engineers, U.S. Army, and assigned as assistant post engineer at Fort Worden, Wash. Until lately he was assistant civil engineer in the Public Works Division of the U.S. Navy, located at Mare Island, Calif.

JOHN F. TRIBBLE recently severed his connection with the Alabama State Highway Department, for which he was research and acting materials engineer, in order to become chief construction engineer for the firm of Goodwin and Van Keuren, on the construction of a flying school at Courtland, Ala.

ROY P. BISHOP now has the rank of major in the Military Police Battalion at Camp Forest, Tenn. Before being called to active duty he was Director of Public Safety for Durham, N.C.

FRANK W. CAWTHON has been promoted from the rank of major in the Army Air Corps to that of lieutenant colonel. His headquarters are in Washington, D.C.

THOMAS P. CUNNINGHAM has been named engineer in charge of the Queens (N.Y.) Topographical Bureau, replacing CHARLES U. POWELL, who retired recently. Prior to his promotion, Mr. Cunningham was principal assistant engineer.

J. W. ELLMS, commissioner of sewage disposal for the city of Columbus, Ohio, is the recipient of the honorary degree of sanitary engineer from the Case School of Applied Science.

W. W. ZASS, president of the Arkansas State Highway Commission, has been called to active duty in the Corps of Engineers, U.S. Army. He has the rank of major.

H. M. BRUSH is now division engineer at Kansas City for the Missouri State Highway Commission. In this capacity he succeeds W. H. BURGWIN who recently accepted a commission as major in the Corps of Engineers.

S. E. MCCULLOUGH, formerly project manager for Brown and Root, Inc., at Texarkana, Tex., has been appointed general manager for a Navy Division Ordnance Plant in Oklahoma.

DECEASED

FREDERICK ABELS ALLNER (M. '40) president of the Safe Harbor Water Power Corporation, Baltimore, Md., died on July 18, 1942. He was 60. Mr. Allner was for many years associated with the Pennsylvania Water and Power Company, of Baltimore, which he served successively as general superintendent and vice-president. He was also engaged on the construction of the Holtwood Dam on the Susquehanna River, which furnished the first hydroelectric power for Baltimore. Long active in the affairs of the Society, Mr. Allner served as president of the Maryland Section in 1941.

ROBERT ADAMS ALLTON (M.'29) died at his home at Hudson, Ohio, on June 24, 1942, at the age of 50. For some years Mr. Allton was with the Chicago firm of Pearse and Greeley. Later (1923 to 1927) he was designing engineer for the Akron (Ohio) Bureau of Sewerage, and from 1928 to 1938 was in charge of the design and construction of a sewage disposal system for the city of Columbus, Ohio. He then became consultant to the Division of Sewage Treatment, and from 1940 until recently was superintendent. During the war he served overseas with the Field Artillery, attaining the rank of major.

ELISHA BROWN BAKER (Assoc. M. '96) retired civil engineer of Utica, N.Y., died in that city on July 12, 1942. Mr. Baker, who was 72, was responsible for the building of the Utica Barge Canal terminal and of a portion of the canal. His other work for that project included the building of seven locks and six dams. He had been assistant city engineer of Utica and, for five years, was city engineer of Gloversville, N.Y. At the time of his retirement in 1932, he was secretary and treasurer of the Mohawk Dredge and Dock Company, at Herkimer, N.Y.

WOOLSEY MOORMAN CAYE (M. '25) technical engineer for the Commissioners of Sewerage at Louisville, Ky., died in that city on July 28, 1942. He was 58. Mr. Caye had been with the Commissioners of Sewerage since 1920. Earlier in his career (1906 to 1915) he was with the city of Louisville in various engineering capacities. He then became connected with the Miami Conservancy District, resigning later for war service as a captain of artillery in the U.S. Army.

THOMAS AVERY CORRY (M. '03) of Los Gatos, Calif., died on May 18, 1942.

at the age of 80. In 1933 Mr. Corry retired with a pension from the Peruvian Southern Railways, after twenty-five years of service as chief engineer. During this period he was stationed in various parts of Peru. For some years, earlier in his career, he had been resident engineer on railroad construction in Mexico for the Mexican Southern Railway.

WILLIAM ASHTON DOBLE (M. '05) retired engineer of San Francisco, Calif., died on June 22, 1942. He was 74. Until his retirement a short time ago Mr. Doble was for many years a member of the San Francisco firm, Doble and Doble. Earlier in his career he was for some time chief engineer for the Pelton Water Wheel Company, of San Francisco. A specialist in the design of hydroelectric generating stations, he had superintended the design and construction of a number of plants in the West.

ALBERT HENRY GREENWOOD (Assoc. M. '05) retired civil engineer of Hartford, Conn., died on July 11, 1942. Mr. Greenwood, who was 55, was a member of the Hartford consulting firm of Greenwood and Noerr from 1910 until his retirement last year. During this period his firm designed and constructed plants for the Royal Typewriter Company and various other organizations.

JOHN COFFEE HAYS (M. '13) executive vice-president of the Stone and Webster Engineering Corporation, died on July 22, 1942. Mr. Hays, who was 60, had been with Stone and Webster since 1919, having become vice-president in 1929. Earlier in his career (1904 to 1907) he was with L. B. Stillwell, New York consultant, and from 1907 to 1915 was president and general manager of a group of utilities and hydroelectric projects in California. During the first World War he was commissioned a major in the Army, serving as construction quartermaster and camp utilities officer at Camp Lewis, Wash.

JULIAN DE BRUYN KOPS (M. '04) of Atlanta, Ga., died in that city on July 7, 1942, at the age of 80. Beginning in 1903, Mr. Kops for many years maintained a consulting practice in Savannah and later opened another office in Atlanta. Earlier in his career he engaged in railroad work, and from 1887 to 1903 was assistant city engineer of Savannah.

JACK MOSKOWITZ (Assoc. M. '21) principal highway engineer for the U.S. Public Roads Administration at Honolulu, Hawaii, died in San Francisco on July 27, 1942. Mr. Moskowitz, who was 56, had been in charge of the P.R.A. office in Hawaii for the past six years, returning to San Francisco for medical treatment about a month ago. Before going to Hawaii he was in the regional office of the Administration in San Francisco.

WALTER HENRY NORRIS (M. '39) retired engineer of Portland, Me., died there on July 11, 1942, at the age of 72. Mr. Norris had been employed for more than thirty years as bridge engineer for the Maine Central Railroad in New England. The many structures and their foundations, for which he was responsible, include five across the Kennebec River and one across the Sheepscott River at Wiscasset.

WILLIAM OEHRLE (M. '24) senior project engineer for the Federal Works Agency of the U.S. Housing Authority, Washington, D.C., died on August 6, 1942. He was 57. Mr. Oehrle had been with the Housing Authority since 1939. Early in his career (1904 to 1923) he was with the George A. Fuller Company, of New York City. Later he maintained his own practice in New York, and from 1932 to 1939 was with the U.S. Treasury Department.

HAROLD TETRICK STURM (Assoc. M. '28) technical service engineer for the Universal Atlas Cement Company, of Columbus, Ohio, died on July 20, 1942. Mr. Sturm, who was 45, had been with the Universal Atlas Cement Company since 1930. Prior to his connection with that organization, he was chief engineer for the Upshur Engineering Company, of Buckhannon, W.Va.

TUDOR ROSSER WILLIAMS (M. '42) consulting engineer of Scranton, Pa., died in that city on July 24, 1942. Mr. Williams, who was 60, spent his entire career in Scranton. He had been engineer for the Scranton Transit Company and in charge of construction for the Washburn-Williams Lumber Company. Later he was with a builders' supply company, La Bar and Williams, disposing of his interest in that organization in 1921 in order to establish the structural practice that he maintained until his death.

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From July 10 to August 9, 1942, Inclusive

ADDITIONS TO MEMBERSHIP

BAYLEY, CHARLES ABERCROMBIE DUNBAR (M. '42), Vice-Pres. and Gen. Mgr., John Monks & Sons, Inc., 438 Broadway, New York, N.Y. (Res., 145 Park St., Montclair, N.J.)

BELL, CHARLES ARTHUR (M. '42), Dist. Engr., State Dept. of Public Works, Capitol Bldg., Baton Rouge, La.

BURRIS, THOMAS FREDERICK (M. '42), Asst. Div. Engr., Pere Marquette Ry. Co., Union Station (Res., 2140 Paris Ave., S.E.), Grand Rapids, Mich.

CALKINS, MYRON DONALD (Jun. '42), Junior Hydr. Engr., U.S. Geological Survey, 606 Post Office Bldg. (Res., 2346 North West Glisan St.), Portland, Ore.

CAMPBELL, CLYDE CECIL (Jun. '42), Eng. Insp., Standard Oil Co. of Indiana, Whiting, Ind. (Res., 8236 South Ridgeland, Chicago, Ill.)

CARLSON, ALBERT WALTER (Assoc. M. '42), Asst. Engr., U.S. Engr. Dept., Office of Area Engr., Green River Ordnance Plant, Dixon, Ill.

CAWELTI, GEORGE EDWARD (Assoc. M. '42), Associate Engr., Defense Plant Corp., 8021 Conant Ave. (Res., 5210 Bishop Rd.), Detroit, Mich.

CHAMBERLAIN, LAWRENCE EARL (Jun. '42), Key Supervisor, Civ. Eng., Pennsylvania State College, 210 Eng. A, State College, Pa.

CLOUGH, ALBERT HASKELL (Assoc. M. '42), Explosive Engr., Atlas Powder Co., 1 Montgomery (Res., 3130 Washington St.), San Francisco, Calif.

COE, DONALD OMER (Assoc. M. '42), Asst. Engr. (Civ.), Design Section, U.S. Engr. Office (Res., 1705 Cherry St.), Vicksburg, Miss.

COOKE, ARTHUR HENRY (Jun. '42), Junior Engr., 3d Locks Project, Diablo Heights, Canal Zone.

CRAYNE, LAURENCE EDMUND (Assoc. M. '42), Junior Bridge Engr., Bridge Dept., State Div. of Highways, 129 West 2d St., Los Angeles (Res., 4571 Highland Ave., San Diego), Calif.

CROSSFIELD, PHILIP JEHIEL (Jun. '42), Asst. Mech. Engr., U.S. Naval Gun Factory, Navy Yard (Res., 18 Ninth St., S.E.), Washington, D.C.

DAVIS, ALLAN RIPLEY, JR. (Assoc. M. '42), Asst. Engr., U.S. Engrs., Denison (Res., Garland), Tex.

DAVIS, DONALD CARTER (Assoc. M. '42), Planning Engr., Planning Commissions, Cities of Modesto and Turlock and Stanislaus County, 616 Tenth St., Modesto, Calif.

DAVIS, THOMAS DALE (Jun. '42), Capt., Coast Artillery Corps, U.S. Army, 369th Coast Artillery (Anti-aircraft), Care, Postmaster, San Francisco, Calif.

DAYETT, GURNEY HENDRICKSON (M. '42), Asst. Engr., Bridges, B. & O. R.R., Charles and Baltimore Sts., Baltimore, Md.

DOOLITTLE, RICHARD NEIL (Jun. '42), Asst. Engr., U.S. Geological Survey, 208 Custom House, Denver, Colo. (Res., 601 Nineteenth, N.W., Washington, D.C.)

DUNKLE, WILLIAM FRANKLIN (Jun. '41), Junior Hydr. Engr., U.S. Geological Survey, Box 149, Fort Smith, Ark.

ELLINWOOD, LEWIS RAY (Assoc. M. '42), Engr. Am. Bridge Co., Frick Bldg. (Res., 405 Oakland Ave.), Pittsburgh, Pa.

ELLIS, HAROLD HERBERT (Jun. '42), Asst. Engr., U.S. Geological Survey, 404 Eng. Experiment Station, Columbus (Res., 1126 Fourth St., N.W., New Philadelphia), Ohio.

EPHROS, ABRAHAM (Jun. '42), Tutor in Civ. Eng., School of Technology, College of City of New York, 140th St. and Amsterdam Ave. (Res., 87 Hamilton Pl.), New York, N.Y.

FORNS, JOSEPH MARIA (Jun. '42), Junior Civ. Engr., TVA, Ocoee 3 Dam, Ducktown, Tenn.

GAREY, IRWIN BUCHANAN (Assoc. M. '42), Designing Engr., Whitman, Requardt & Smith, Rocky Mountain Arsenal (Res., 2174 South Emerson St.), Denver, Colo.

GASPERETTI, EUSTACHIO JOSEPH (Jun. '42), Junior Engr., The Panama Canal, Box 596, Diablo Heights, Canal Zone.

GAUGER, RAYMOND JULIUS (M. '42), Cons. Engr., 601 Carolina Ave., North Augusta, S.C.

GOLDFINGER, HENRY (M. '42), Chf. Engr., Foley Brothers Inc., and Spencer, White & Prentis, Inc., 86 Trinity Pl. (Res., 2784 Morris Ave.), New York, N.Y.

GOLDSMITH, MORRIS KING (Assoc. M. '42), Structural Engr., Taylor & Taylor, 803 West 3d St. (Res., 3714 Lorado Way), Los Angeles, Calif.

GRILLO, ODAIR (Jun. '42) Chf., Div. of Soils and Foundations, Inst. for Technological Research, Praca Cel Fernando Prestes 110 (Res., Rua Mello Alves 493) São Paulo, Brazil.

HARLOW, EUGENE HARRISON (Assoc. M. '42), Foundation Engr., Frederic R. Harris, Inc.,

27 William St., New York, N.Y. (Res., 218 Claremont Rd., Springfield, Pa.)

HARRILL, CHIVOUS GILMER (Jun. '42), Structural Engr., Giffels & Vallet, Naval Operating Base (Res., 1318 Sewells Point Rd.), Norfolk, Va.

HENNINGS, JOHN PORTER (Assoc. M. '42), Engr., Shenango Valley Water Co., 100 Shenango Ave., Sharon, Pa.

HUTCHENS, HAROLD RAYMOND (Jun. '42), Chf. Draftsman, Marshall & Brown, 114 West 10th St., Kansas City, Mo.

JOE, ALVIN KAY YIP (Jun. '42), Mech. Eng. Draftsman, Utah Copper Co., 719 Kearns Bldg. (Res., 123 South West Temple St.), Salt Lake City, Utah.

KAROL, JACOB (Assoc. M. '42), Structural Engr., Airplane Div., Curtiss-Wright Corp., Lambert Field, Robertson (Res., 5370 Pershing, St. Louis), Mo.

KAUFMAN, ALFRED (Jun. '42), 2d Lt., Coast Artillery, U.S. Army, Army Post Office 817, Care, Postmaster, San Francisco (Res., 1016 South Plymouth Blvd., Los Angeles), Calif.

LANDER, LUIS WANNONI (Jun. '42), Civ. and San Engr., Div. de Ingenieria Sanitaria, Sur 4, No. 87, Caracas, Venezuela.

LARSON, EDWARD (Assoc. M. '42), Executive Secy., National Society of Professional Engrs., National Press Bldg., Washington, D.C.

LEE, MERLIN ELLSWORTH (Jun. '42), Ensign, U.S.N.R., Asst. Officer in Chg., Constr., Box 112, Morgan City, La.

LITTON, HAILEY CLIFTON (Assoc. M. '42), Asst Engr. (Structural), U.S.N., Bureau of Yards and Docks, Navy Bldg., Washington, D.C. (Res., 503 West C St., Elizabethton, Tenn.)

LOUGHIN, MARSHALL IMOGENE (Jun. '42), Field Engr., M. W. Kellogg Co., Aruba (Res., 709 Dewey Ave., Ann Arbor), Mich.

MCKEE, ROBERT BRADFORD (Jun. '42), Associate Engr., U.S. Engr. Office, 960 Ellicott Sq. Bldg., Buffalo, N.Y.

MADGEN, LYNN SPENCER (Jun. '42), Care, California Arabian Standard Oil Co., Bahrein Island, Persian Gulf.

MILLER, CHARLES ALBERT (M. '42), City Mgr., Traverse City, Mich.

MOHR, ALFRED BECKER (Jun. '42), Civ. Engr., Sherwood-Templeton Coal Co., 289 North Main St. (Res., 190 B St., N.E.), Linton, Ind.

MURRAY, JOHN JOSEPH (Assoc. M. '42), Div. Engr., Bureau of Building Inspection, 210 City-County Bldg. (Res., 807 South Braddock Ave.), Pittsburgh, Pa.

NAGIN, HAROLD (Assoc. M. '42), Chf. Engr., Reliance Steel Products Co., 3700 Walnut St., McKeesport (Res., 5630 Beacon St., Pittsburgh), Pa.

NEUMANN, ERNEST LESLIE (Jun. '41), Asst. City Director, Senior Engr., City of Monroe, Municipal Bldg., Monroe, Mich.

PATON, WILLIAM GRAHAM (M. '42), Asst. to Gen. Mgr., The Austin Co., 16112 Euclid Ave., Cleveland (Res., 1136 Brentwood Rd., Cleveland Heights), Ohio.

PFEILER, ARNO JOSEPH (Assoc. M. '42), 1st Lt., Sn. Co., U.S. Army, Station Hospital, Elgin Field, Fla.

PHILLIPS, HENRY ARTHUR (Jun. '42), Checker and Design Draftsman, Met. Dist., Water Bureau, 1026 Main St. (Res., 851 Wethersfield Ave.), Hartford, Conn.

RAMSEY, EMORY FRED (Jun. '42), Insp., E. I. du Pont de Nemours & Co., 2154 University Ave., Morgantown, W.Va.

RANSON, RICHARD ROSE (M. '42), Design Engr., Cutler-Hammer, Inc., 315 North 12th St. (Res., 4951 North Newhall St.), Milwaukee, Wis.

RAU, CLYDE EDWARD (Jun. '42), Chf. Surv., Finn, Stokes, Taylor & Bible, China Spring Airfield, Waco, Tex.

REID, GRAEME (Assoc. M. '42), Cons. Transportation Engr., Hawthorne Rd., Essex Fells, N.J.

RUSSELL, LEROY BURNETT (Assoc. M. '42), Asst. Engr., Indian Irrig. Service, U.S. Dept. of Interior, 751 South Figueroa St., Room 523, Los Angeles, Calif.

SAUNDERS, GEORGE WASHINGTON (M. '42), Office Engr., E. B. Badger & Sons Co., 75 Pitts St., Boston, Mass.

SCOTT, ROBERT DAY (Assoc. M. '42), Structural Engr., Federal Housing Administration, Vermont & K St. (Res., 3829 W St., S.E.), Washington, D.C.

SEXTON, HAROLD WEBER (Jun. '42), 2d Lt., Corps of Engrs., U.S. Army, 340th Engrs., Army Post Office 934, Seattle, Wash.

SHANDLOFF, ARTHUR MORDECAI (Jun. '42), Asst. Office Engr., U.S. Engr. Office, Hobe Sound (Res., 350 South West 21st Rd., Miami), Fla.

SHUMAKER, LOY EUGENE (Assoc. M. '42), Junior Engr. (Civ.), U.S. Engr. Dept., Wright Field (Res., 37 Bond St.), Dayton, Ohio.

SOLOMON, SHELDON KIRSNER (Jun. '42), Junior Civ. Engr., P-1, Public Works Dept., U.S.N., 90 Church St., New York (Res., 322 East 48th St., Brooklyn), N.Y.

STENEN, NORMAN HANSON (Jun. '42), 8802 Darby Ave., Northridge, Calif.

TAGGART, WILLIAM NAGELE (Jun. '42), Ensign, CEC-V(S), U.S.N.R., Bureau of Yards and Docks, Washington, D.C. (Res., 6029 Baltimore Ave., Riverdale, Md.)

TESKE, WILMER EDWIN (Jun. '42), Soils Investigator, State Highway Comm., 532 West Market (Res., 34 North Sheffield), Indianapolis, Ind.

TURNER, LEON BELA (Assoc. M. '42), Maj., Corps of Engrs., U.S. Army, New War Dept. Bldg. (Res., 2001 Eye St., N.W.), Washington, D.C.

TURNER, NATHANIEL PARKER, JR. (Assoc. M. '42), (Lockwood & Andrews, Turner & White), Union National Bank Bldg., 2d Floor (Res., 1930 Addison St.), Houston, Tex.

UTEGAARD, THOMAS (M. '42), Asst. Chf. Engr., Consolidated Water Power & Paper Co., Wisconsin Rapids, Wis.

MEMBERSHIP TRANSFERS

ACTON, JOSEPH PAUL (Jun. '36; Assoc. M. '42), Care, Airport Development Dept., Pan Am. Airways, Dupont Bldg., Miami, Fla.

ALLAN, ROBERT MYERS (Jun. '35; Assoc. M. '42), Engr., W. A. Bechtel Co., 155 Sansome St., San Francisco (Res., 926 Carmel Ave., Albany), Calif.

ANGELL, LESTER WILLIAM (Jun. '33; Assoc. M. '37; M. '42), Engr. (Structural), U.S. Engr. Dept., 120 Wall St., New York, N.Y.

BENJES, HENRY HERMAN (Jun. '35; Assoc. M. '42), Asst. Engr., Black & Veatch Box 904 (Res., 2401 South M), Fort Smith, Ark.

BLANK ROTH, CESAR AUGUSTO (Jun. '35; Assoc. M. '42), Chf. Engr., Obras de Riego S. Carlos, Ministerio de Obras Publicas, San Carlos, Cojedes (Res., Este 13, No. 30, Caracas), Venezuela.

BLUME, JOHN AUGUST (Jun. '35; Assoc. M. '42), Structural Engr., H. J. Brunnier, 612 Sharon Bldg. (Res., 625 Bush St.), San Francisco, Calif.

BRUMBAUGH, JOHN ERNEST (Jun. '35; Assoc. M. '42), Village Engr., Municipal Bldg. (Res., Pleasantville Rd.), Briarcliff Manor, N.Y.

CALLAHAN, SAMUEL JOSEPH (Assoc. M. '34; M. '42), Res. Chf. Engr., Smith, Hinchman & Grylls, Inc., Lake City Ordnance Plant, Independence (Res., 7245 Jefferson St., Kansas City), Mo.

CAMPBELL, MORGAN SKILES (Jun. '31; Assoc. M. '42), Associate Engr., U.S. Engr. Office (Res., 4824 Austin Drive), Galveston, Tex.

CAROLLO, JOHN ANDREW (Assoc. M. '36; M. '42), (Headman-Ferguson & Carollo), 319 Homebuilders Bldg., Phoenix, Ariz.

CORTRIGHT, HARRY MILLER (Jun. '35; Assoc. M. '42), Lt. (jg), CEC-V(S), U.S.N.R., Bureau of Yards and Docks (Res., 3736 Northampton St., N.W.), Washington, D.C.

CRUICKSHANK, DOUGLAS SPENCER (Jun. '35; Assoc. M. '42), Associate Engr. (Civ.), South Pacific Div., U.S. Engr. Dept., 351 California St., San Francisco, Calif.

CULLINAN, ROY BERNARD (Jun. '34; Assoc. M. '42), Res. Engr., State Dept. of Public Works, 476 Main St., Worcester (Res., 4 Garden St., Auburn), Mass.

DAVIS, LEROY MILTON (Assoc. M. '31; M. '42), Hydr. Test Engr., Pennsylvania Water & Power Co., Holtwood, Pa.

EGBERT, FORD (Jun. '35; Assoc. M. '42), Asst. Engr. (Structural), U.S. Engr. Office (Res., 711 Seventh St.), Galveston, Tex.

FICARRATTO, SADO CARL (Jun. '38; Assoc. M. '42), Asst. Engr., U.S. Engr. Office, Wright Bldg., Sacramento, Calif.

FITZGERALD, JAMES (Jun. '35; Assoc. M. '42), Lt., CEC, U.S.N., Public Works Officer, Naval Air Station, Miami, Fla.

HAMILTON, DONALD MACKENZIE (Jun. '35; Assoc. M. '42), Chf. Engr., Gloucester Emergency Power Station, Charles Brand & Son Ltd., 25–27 Charles II St., London, S.W.1, England (Res., 14 Braidburn Terrace, Edinburgh, Scotland.)

HOGLIN, HAROLD ALVIN (Jun. '38; Assoc. M. '42), Lt. (jg), CEC-V(S), U.S.N.R., Bureau of Yards and Docks, Washington, D.C. (Res., 3114 Tenth Rd., North, Apt. 18, Arlington, Va.)

JOHNSON, BARCLAY GIDDINGS (Jun. '32; Assoc. M. '42), Lt. (jg), CEC, U.S.N.R., Asst. Res. Officer in Chg., Camp Pendleton, Oceanside, Calif.

JOHNSON, IRVING LAURENCE (Jun. '32; Assoc. M. '35; M. '42), Lt., CEC, U.S.N.R., Care, Dist. Public Works Office, Pearl Harbor, Hawaii.

LESSIG, LESTER L. (Assoc. M. '29; M. '42), Maj., Corps of Engrs., U.S. Army, 312 Winding Way, Merion, Pa.

LILLEY, GORDON ARTHUR (Jun. '31; Assoc. M. '41), Sub-Dist. Engr., U.S. Army Engrs., 501 West B St. (Res., 4377 Newport Ave., Ocean Beach), San Diego, Calif.

LYELL, HERBERT LESLIE (Jun. '38; Assoc. M. '42), Structural Designer, H. J. Brunnier, 612 Sharon Bldg., San Francisco (Res., 467 Tennyson Ave., Palo Alto), Calif.

MAIERHOFER, CHARLES RICHARD (Jun. '38; Assoc. M. '42), Asst. Engr., U.S. Bureau of Reclamation, Marshall Ford Dam, Tex.

PIKE, THOMAS OLIVER (Jun. '33; Assoc. M. '42), Associate Engr., The Panama Canal, Drawer B, Gatun, Canal Zone.

PRITCHARD, FRANCIS THOMAS (Jun. '30; Assoc. M. '42), Lt. (jg), CEC, U.S.N.R., Bureau of Yards and Docks, Washington, D.C. (Res., 5925 Chabot Rd., Oakland, Calif.)

SEARCY, JAMES KINCHEON (Jun. '38; Assoc. M. '42), Capt., Coast Artillery Corps, U.S. Army, Reception Center, Camp Shelby (Res., 424 West Pine St., Hattiesburg), Miss.

SEIFRIED, JOHN FRANCIS (Assoc. M. '20; M. '42), Asst. Dist. Mgr., Ceco Steel Products Corp., 1926 South 52d Ave., Chicago (Res., 1119 Bonnie Brae, River Forest), Ill.

SORKIN, JOSEF (Jun. '29; Assoc. M. '35; M. '42), Office Engr., Howard, Needles, Tammen & Bergendoff, 1012 Baltimore Ave., Kansas City, Mo. (Res., 2005 Austin Ave., Apt. A, Waco, Tex.)

THIELHELM, HAROLD WILLIAM (Jun. '32; Assoc. M. '42), Office Engr., Lago Petroleum Corp., Maracaibo, Venezuela.

VOCKROTH, JOHN HENRY (Jun. '35; Assoc. M. '42), Structural Engr., Pine Brook Iron Works, 105 Middle St. (Res., 1001 Prescott Ave.), Scranton, Pa.

VOGELGESANG, CARL EDGAR (Assoc. M. '35; M. '42), Engr. of Road Design, State Highway Comm., State House Annex (Res., 5218 Kenwood Ave.), Indianapolis, Ind.

WILKINSON, JACKSON HEATH (Assoc. M. '29; M. '42), Senior Highway Engr., TVA, 701 Union Bldg., Knoxville, Tenn.

TOTAL MEMBERSHIP AS OF AUGUST 9, 1942

Members	5,806
Associate Members	7,021
Corporate Members	12,827
Honorary Members	35
Juniors	4,999
Affiliates	71
Fellows	1
Total	17,933

REINSTATEMENTS

ABELL, DEWITT STERLING, Assoc. M., reinstated July 20, 1942.

GOULD, HAROLD MOFFET, Assoc. M., reinstated July 20, 1942.

MAU, CARL FREDERICK, Assoc. M., reinstated Aug. 4, 1942.

ROBERTS, ALEX ACKLAND, Jun., reinstated July 13, 1942.

RESIGNATIONS

GRASIER, FREDERICK ARDEN, Jun., resigned June 30, 1942.

MOORE, FRANK HARDY, JR., Jun., resigned July 16, 1942.

Applications for Admission or Transfer

Condensed Records to Facilitate Comment from Members to Board of Direction

September 1, 1942 NUMBER 9

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every member is urged, therefore, to scan carefully the list of candidates published each month in CIVIL ENGINEERING *and to furnish the Board with data which may aid in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board.

Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North America until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

GRADE	GENERAL REQUIREMENT	AGE	LENGTH OF ACTIVE PRACTICE	RESPONSIBLE CHARGE OF WORK
Member	Qualified to design as well as to direct important work	35 years	12 years	5 years RCM*
Associate Member	Qualified to direct work	27 years	8 years	1 year RCA*
Junior	Qualified for sub-professional work	20 years	4 years	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years	5 years RCM*

* In the following list RCA (responsible charge—Associate Member standard) denotes years of responsible charge of work as principal or subordinate, and RCM (responsible charge—Member standard) denotes years of responsible charge of IMPORTANT work, i. e., work of considerable magnitude or considerable complexity.

APPLYING FOR MEMBER

BOYLE, FRANK JOSEPH, Pittsburgh, Pa. (Age 46) (Claims RCA 11.0 RCM 9.0) 1938 to date successively as Res. Engr. Inspector, PWA, Washington, D.C., and (since 1940) in Allegheny County Dept. of Public Works as Designer-Draftsman in Bridge Dept.

BAUSH, GORTON WILLIAM (Assoc. M.), Pascagoula, Miss. (Age 47) (Claims RCA 7.3 RCM 16.1) Oct. 1940 to date Plant Engr., Ingalls Shipbuilding Corporation; previously Constr. Engr., Board of Water & Elec. Light Comm.; Vice-Pres. and Gen. Mgr., Michigan Clay Products Corporation, Williamston, Mich.

CATHERS, CHARLES PERCY, JR., Little Rock, Ark. (Age 44) (Claims RCA 5.1 RCM 13.4) Nov. 1941 to date Superv. Engr., RFC, Washington, D.C.; previously Associate Engr., Kansas Highway Dept., Topeka, Kans.; Cons. Engr. in private practice; Government, Superv. Engr., Chanute, Kans.

COGAN, MYLES HONOHAN RESUGGAN, Houston, Tex. (Age 40) (Claims RCM 14.0) July 1941 to date Designing Eng. Draftsman, Shell Oil Corporation, Chemical Div., Deer Park, Tex.; previously Designing Engr. and Office Mgr. with McEvoy Co. on government contract; Asst. Chf. Engr. of Refinery, Anglo-Egyptian Oilfields, Ltd., Suez, Egypt; Constr. Overseer, C.P.I.M., Curacao, Dutch West Indies; with Mexican Eagle Oil Co. Ltd., Tampico, Mex.

COLLINS, ROBERT WETMORE (Assoc. M.), Houston, Tex. (Age 47) (Claims RCA 5.5 RCM 16.5) Feb. 1923 to date with Southwestern Constr. Co., as Mgr., Vice-Pres., and (since May 1932) Pres.

DEVINE, WALTER ANTHONY, Brookline, Mass. (Age 54) (Claims RCM 27.0) April 1906 to date with Eng. Dept., Brookline, Mass., in various capacities, since April 1940 as Town Engr.

DOAN, LESLIE AMOS (Assoc. M.), Trenton, Mich. (Age 54) (Claims RCA 6.8 RCM 18.2) Jan. 1929 to date Village Engr., Trenton, Mich.

GORGENSON, ERIC GEORGE LEONARD, Minneapolis, Minn. (Age 49) (Claims RCA 9.6 RCM 15.9) Sept. 1930 to Oct. 1938 Bridge Designer and Oct. 1938 to date City Bridge Engr., Minneapolis.

HEYSER, ALTON SCHULZE (Assoc. M.), St. George's, Bermuda. (Age 37) (Claims RCA 2.1 RCM 8.2) March 1941 to date Executive Asst. to Chf. of Group (Metcalf & Eddy; Ford, Bacon & Davis, Inc.; Shaw, Naess & Murphy); previously with Walter Kidde Constructors, Board of Water Supply, New York City, Foster Wheeler Corporation, etc.

HOFF, TRYGVE WALDEMAR, Baltimore, Md. (Age 43) (Claims RCA 7.5 RCM 6.7) March 1942 to date Prin. Designing Engr., J. E. Greiner Co.; previously Drafting Room Mgr., Ravenna (Ohio) Ordnance Plant; Bridge Designer, Cuyhoga County Eng. Dept.

HOFFMAN, OSCAR, Cleveland Heights, Ohio. (Age 45) (Claims RCA 7.3 RCM 10.0) April to Aug. 1939 and Oct. 1940 to July 1941 Visiting Prof. and Sept. 1941 to date Asst. Prof. of Structural Eng., Penn Coll., at present Associate Prof.; previously Structural Designer, Hausman Steel Co., Toledo; Associate Prof. of Structural Eng., Royal Polytechnic Inst., Milan, Italy.

JAMES, JOHN RAYMOND, Detroit, Mich. (Age 56) (Claims RCA 8.7 RCM 12.0) 1925 to date Senior Engr., Eng. Div., The Detroit (Mich.) Edison Co.

JAMES, WILBUR OAKLEY, Upper Darby, Pa. (Age 44) (Claims RCM 17.8) July 1941 to date Executive Asst. to Pres., Eastern Sand & Gravel Corporation, Eastern Asphalt Co., The Liberty Corporation; previously Salesman and Engr., Westinghouse Elec. & Mfg. Co.

JOHNSON, ELLWOOD, Blue Plains, Washington, D.C. (Age 57) (Claims RCA 7.2 RCM 16.1) Dec. 1936 to date with Sewer Div., Dept. of San. Eng., as Supt., acting as Administrative Officer of sewage-treatment plant.

KEHART, MARTIN WILLIAM (Assoc. M.), Pearl Harbor, Hawaii. (Age 40) (Claims RCA 5.0 RCM 9.6) Sept. 1939 Lt. Comdr., Civ. Engr. Corps, USNR, at present acting as Project Mgr.; previously with PWA, FWA; with Bridge Dept., Arkansas Highway Comm.

LEUE, CONRAD FERDINAND (Assoc. M.), Washington, D.C. (Age 62) (Claims RCA 17.9 RCM 18.5) Sept. 1941 to date on temporary duty as Engr. Draftsman, Dist. of Columbia Mun. Govt.; previously promoting exploratory test well drilling of potential oil and gas territory.

MCGLYNN, JAMES JOSEPH, Philadelphia, Pa. (Age 57) (Claims RCA 1.0 RCM 25.0) 1905 to date with Lit Bros., in various capacities, and (since 1917) Chf. Engr.

MILLER, ERVIN JOHN, Minneapolis, Minn. (Age 55) (Claims RCA 15.1 RCM 14.1) Oct. 1933 to date with Minnesota Dept. of Highways, St. Paul, as Asst. Bridge Engr., and (since Jan. 1939) Chf. Bridge Engr.

PRUETT, WILLIAM GUERRY, Montgomery, Ala. (Age 36) (Claims RCA 1.8 RCM 6.9) June 1927 to date with Alabama Highway Dept. in various capacities, since Feb. 1942 as State Highway Director.

RICE, ERNEST GRAHAM (Assoc. M.), Portland, Ore. (Age 56) (Claims RCA 3.3 RCM 12.5) July 1940 to date with John W. Cunningham & Associates as Engr., and (since Oct. 1941) Project Engr.; previously Research Engr., Weyerhaeuser Timber Co., St. Paul, Minn.; Pres. and Gen. Mgr., Monarch Pipe & Creosoting Co., Tacoma, Wash.

RIVA, CHARLES WINSLOW, Cranston, R.I. (Age 41) (Claims RCA 6.1 RCM 8.2) May 1939 to date Res. Engr., Fay, Spofford & Thorndike, Boston, Mass.; previously Chf. Engr. and Gen. Supt., Board of Sewer Commrs., Saugus, Mass.; Estimator, Coughlan Constr. Co., Boston; Supt., Underground Steam Constr. Co., Boston.

RUMBILL, HENRY CRAWFORD, San Juan, Puerto Rico. (Age 40) (Claims RC 16.5) March 1942 to date Field Engr. with Arundel Corporation, loaned to U.S. Navy; previously State Field Engr., WPA.

SCHORER, HERMAN (Assoc. M.), New York City. (Age 50) (Claims RCA 7.6 RCM 11.8) Feb. 1934 to date Manager and Pres., Borsari Tank Corporation of America.

SHEEHAN, PETER PATRICK, Cambridge, Ohio. (Age 51) (Claims RCA 9.0 RCM 9.0) 1937 to date City Engr., Cambridge, Ohio.

SMITH, ROBERT JOSEPH, Chicago, Ill. (Age 58) (Claims RCA 9.0 RCM 8.7) 1940 to date with James Stewart Co.; previously with Calumet Ship Yard and Dry Dock Co.

SPICKARD, HAROLD EWING, El Monte, Calif. (Age 47) (Claims RCA 3.5 RCM 12.3) Oct. 1935 to date with U.S. Engrs., Los Angeles, Calif., in various capacities, since May 1940 Prin. Engr.

STROM, JOHN, Little Rock, Ark. (Age 55) (Claims RCA 13.7 RCM 12.8) April 1934 to date with Arkansas Highway Comm. as Designer and Senior Highway Engr.

TEVIS, CHARLES CYRUS, Kirkwood, Mo. (Age 41) (Claims RCA 5.2 RCM 12.3) June 1923 to date with Missouri Highway Dept. in various capacities, since June 1940 as Senior Engr.

TOUR, HARRY BIRD (Assoc. M.), Norris, Tenn. (Age 42) (Claims RCA 8.5 RCM 10.0) Sept. 1935 to date with TVA as Superv. Archt. on Norris Dam, and (since Sept. 1936) Prin. Archt.

TRASK, GEORGE FRANCIS DONNELL, Washington, D.C. (Age 74) (Claims RCA 19.0 RCM 21.5) 1941 to date Head Mech. Engr., Constr. Div., Q.M.C. and Corps of Engrs., U.S. Army; previously Treas. and Gen. Mgr., Baskahegan Lumber Co., New York and Danforth, Maine; Pres. and Gen. Mgr., Danforth (Me.) Elec. Co.

WALKER, EDWARD MANSFIELD, Detroit, Mich. (Age 63) (Claims RCA 7.4 RCM 31.0) July 1926 to date in private practice as Cons. Civ. Engr.

WATTS, AUBREY BYRON (Assoc. M.), Little Rock, Ark. (Age 43) (Claims RCA 1.0 RCM 9.3) Aug. 1938 to Aug. 1941 and April 1942 to date with U.S. Engr. Office, as Inspector, and (since April 1942) Asst. Constr. Engr.; in the interim Chf. Inspector with Black & Veatch.

ZELNER, OTTO SAMUEL, St. Paul, Minn. (Age 64) (Claims RCA 11.5 RCM 20.0) Jan. 1910 to date at Univ. of Minnesota, as Asst. Prof., and (since 1923) Associate Prof., of Surveying.

APPLYING FOR ASSOCIATE MEMBER

AVELLA, SALVATORE RALPH, St. George's, Bermuda (permanent address New York City). (Age 37) (Claims RCA 7.4) May 1941 to date Senior Engr. with Shaw, Naess & Murphy; Ford, Bacon & Davis, Inc., and Metcalf & Eddy, Archt.-Engrs.; previously with Murphy-Persicano, Queens Water Pipe Constr. Corporation, Provisero Constr. Corporation, and Prath-Mor Constr. Corporation.

BEADLE, HERBERT J, Austin, Tex. (Age 44) (Claims RCA 6.0) 1942 B.S. in C.E., Univ. of Tex.; March 1929 to Jan. 1935 Asst. Res. Engr. and Res. Engr., Texas State Highway Dept.

BELZ, CHARLES ALBERT, Lansdale, Pa. (Age 42) (Claims RCA 18.7 RCM 0.6) June 1929 to date Sales Engr., Bethlehem Steel Co., Philadelphia, Pa.

BOGAN, BERNARD ROBERT, Berkeley, Calif. (Age 31) (Claims RCA 3.6 D 3.4) June 1942 to date Senior Eng. Aide, Kaiser Co., Inc.; previously Jun. Engr. and Surveyman, Lubbock Army Flying School, U.S. Engrs.; with The State-Wide Highway Planning Survey, State Highway Dept., Austin, Tex.

CARTER, RUFUS HENRY, JR. (Junior), Santa Fe, N. Mex. (Age 32) (Claims RCA 3.4 RCM 1.4) July 1942 to date Secy., Rio Grande Compact Comm.; previously Engr., State Engr.'s Office, Santa Fe; with New Mexico Highway Dept.

CHAPIN, DOUGLAS BRYANT, Balboa, Canal Zone. (Age 55) (Claims RCA 14.0 RCM 2.0) July 1941 to date Asst. Gen. Supt., Swinerton, Hegeman & McClure, Navy Contrs.; previously Res. Engr., Leonard Constr. Co., Coco Solo, Canal Zone; Asst. Supt., Fort Jay, Governors Island, N.Y.; Chf., Planning Sec., and Res. Engr., North Beach Airport, LaGuardia Field.

COLBERT, WILLIAM EMMETT, Care, Postmaster, New York City. (Age 39) (Claims RCA 5.2 RCM 2.8) March 1939 to date Res. Engr., 2 years with Mun. Archt.'s Office, District of Columbia Govt., and (since March 1941) on construction for U.S. Govt. outside Continental U.S.; previously in private practice.

CUBBISON, GERALD LLOYD (Junior), Knoxville, Tenn. (Age 31) (Claims RCA 1.5) April 1937 to date with TVA as Jun. and Asst. Eng. Draftsman, Eng. Draftsman, Jun. Civ. Engr., Asst. Civ. Engr., and (since Feb. 1942) Associate Civ. Engr.

DALZELL, CHESTER LAWTON (Junior), Great Kills, N.Y. (Age 31) (Claims RCA 3.7) Oct. 1936 to date with Procter and Gamble Mfg. Co., Port Ivory, N.Y., as Draftsman, Engr., Chf. Draftsman and Estimator.

EFFERSON, WILLIAM CARSON, Quiriquire, Venezuela. (Age 36) (Claims RCA 3.8) May 1939 to date with Standard Oil Co. of Venezuela as Constr. Engr., and (since May 1942) Dist. Engr.; previously with Louisiana Highway Comm.

FRIEDMAN, JOSEPH LYON (Junior), Richmond, Calif. (Age 30) (Claims RCA 6.3) Jan. 1941 to date Eng. Asst. to Gen. Mgr., Permanente Metals Corporation and Kaiser Co. Inc.; previously Asst. to Cons. Engr., Brown-Bellows-Columbia, U.S. Naval Air Station, Corpus Christi, Tex.; Engr., Estimating Dept., Consolidated Builders, Inc., Mason City, Wash.

GRIFFIN, HENRY PORTER, McAllen, Tex. (Age 55) (Claims RCA 13.2) 1935 to 1936 and 1937 to date Engr., Hidalgo County; in the interim Field Supt., WPA, Dist. No. 11, Laredo, Tex.

HACKNEY, JOHN WILLIAM (Junior), Burlington, N.J. (Age 30) (Claims RCA 4.0 RCM 3.0) Aug. 1935 to date with Aluminum Company of America, as Engr., and (since May 1942) Constr. Supt.

HARNETT, JAMES JOSEPH, Bronxville, N.Y. (Age 38) (Claims RCA 13.7) 1929 to date with Lawrence Properties, Bronxville, N.Y., as Constr. Engr.

KERSHAW, JOHN KNOX, Birmingham, Ala. (Age 39) (Claims RCA 10.7) 1938 to date in private practice as Prof. Engr.; previously with Etowah County, Ala.

KUMPF, GEORGE (Junior), Milwaukee, Wis. (Age 31) (Claims RCA 5.4 RCM 1.0) Aug. 1932 to date with Corps of Engrs., U.S. Army in various capacities, since May 1942 Dist. Engr., U.S. Engr. Office, Milwaukee; at present Major.

LAKE, KENNETH ANDREW, Philadelphia, Pa. (Age 37) (Claims RCA 7.2 RCM 3.1) April 1941 to date Lieut., Corps of Civ. Engrs., U.S. Navy; previously with WPA as Asst. Engr., Engr., Asst. Superv. Engr. and Jun. Adm. Engr.

LEVANTINE, LEO BURTON, Philadelphia, Pa. (Age 35) (Claims RCA 7.0) Jan. 1941 to date with Dept. of Public Works, 4th Naval Dist. as Field Engr. and past 6 months as Project Mgr.; previously Field Engr. successively with Port of New York Authority and New York City Tunnel Authority.

LYDER, GEORGE LESLIE, San Fernando, Trinidad, B.W.I. (Age 30) (Claims RCA 3.0) July 1940 to date Eng. Surveyor, Trinidad Leaseholds Ltd.; previously Exploratory Geologist and Surveyor, Antilles Petroleum Co. (Trinidad), Ltd.

MCGAUGHY, JOHN BELL (Junior), Norfolk, Va. (Age 27) (Claims RCA 3.5) June to Aug. 1939 and May 1941 to date with U.S. Engr. Dept., as Civ. Eng. Draftsman, Prel. Design Sec.; in the interim with Constr. QM, U.S. Army, and as Inspector on additions to Naval Hospital, Portsmouth, Va.; Project Supervisor, NYA; with U.S. Coast Guard.

MAHER, CHARLES EDWARD, Kansas City, Mo. (Age 30) (Claims RCA 3.6 RCM 2.4) Aug. 1940 to date with U.S. Engr. Dept., as Chf. Inspector, Jun. Engr. (Civil), Cost and Project Engr. and Asst. to Camp Engr., Camp Chaffee, Ft. Smith, Ark., and (since May 1942) Asst. Engr. (Civil), and Asst. Area Engr., Sherman Field, Ft. Leavenworth, Kans.; previously with Rawlins (Kans.) County Highway Dept.

MANSUR, CLINE LEE (Junior), Phoenix, Ariz. (Age 27) (Claims RCA 2.7 RCM 2.0) Aug. 1941 to date at Luke Field, as 1st. Lt., and (since Feb. 1942) Capt.; previously Asst. Engr., Holway & Cochrane, Archt.-Engrs., Muskogee, Okla.; with Holway and Neuffer, Engrs., Vinita, Okla.; with Dept. of Utilities, Univ. of Oklahoma, Norman, Okla.

NYLINE, BENNETT PHILIP, Seattle, Wash. (Age 35) (Claims RCA 4.4 RCM 2.8) Jan. 1933 to date with U.S. Engrs. as Inspector, Jun. Engr., Asst. Engr., Associate Engr. and Engr.

POWELL, HAGAN, Richmond, Ky. (Age 30) (Claims RCA 5.4) April 1936 to date with Freeland, Roberts & Co., Cons. Engrs., Nashville, Tenn., as Res. Engr., Div. Engr., and at present Asst. Project Engr. on Blue Grass Ordnance Depot.

SARLES, FRANK BENTON, Pando, Colo. (Age 41) (Claims RCA 7.8 RCM 11.3) Oct. 1940 to date with Black and Veatch, as Materials Engr., Asst. Engr. (Dept. Head), and (since May 1942) Eng. Coordinator; previously with Arkansas Highway Dept.

SHANNON, WILLIAM GILMORE, Columbia, S.C. (Age 28) (Claims RCA 2.3 RCM 2.6) July 1934 to date with SCS in travel status as Rodman, Instrumentman, Chf. of Survey Party, and (since Feb. 1941) Asst. Engr.

SMITH, SIDNEY NORTON, Hiwassee Dam, N.C. (Age 35) (Claims RCA 5.5 RCM 1.0) March 1935 to date with TVA in various capacities, since July 1941 as Asst. Constr. Engr. of Apalachia Dam.

SMITHSON, THOMAS, Portland, Ore. (Age 31) (Claims RCA 4.1 RCM 0.5) July 1942 to date with John W. Cunningham and Associates, Engrs.; previously Designing Engr. with R. H. Corey, Portland; Cons. Engr. in partnership with W. B. Gilbert, Ore.; Contr.'s Engr., Johnson Constr. Co.

STERN, GEORGE, New York City. (Age 32) (Claims RCA 1.7) At present with Waddell & Hardesty, Cons. Engrs., New York City, as Designer; Aug. 1937 to April 1939 Engr. on work for coal mine, Trbovlje, Yugoslavia.

STILWELL, DAVID WYNNEGATE, Los Angeles, Calif. (Age 43) (Claims RCA 8.2) April 1942 to date with War Dept., Los Angeles Engr. Dist. being Head, Constr. Control Sec., Mil. Eng. Div.; previously with 1st Regt. Engrs., California State Guard as Commanding Officer; Gen. Supt. and Engr., California Constr. Co.

SUNDSTROM, HARALD JOSEPH (Junior), Louisville, Ky. (Age 32) (Claims RCA 5.8 RCM 3.0) Nov. 1937 to date with U.S. Engr. Office as Jun. Engr., Prin. Eng. Aide, Asst. Engr., and Associate Engr.

VERJBITSKY, PAUL FADD, Albuquerque, N.Mex. (Age 50) (Claims RC 6.0 D 4.0) Dec. 1933 to date with U.S. Engrs., Albuquerque (N.Mex.) Dist. as Senior Draftsman, Chf. Draftsman and Associate Engr. (Structural and Sanitary).

WILSON, OWEN MCGLASHAN, Los Angeles, Calif. (Age 38) (Claims RCA 12.1) May 1930 to date Asst. Engr., The Metropolitan Water Dist. of Southern California.

WINSLOW, BURTON LYMAN, Bennington, Vt. (Age 59) (Claims RCA 26.3 RCM 10.1) May 1942 to date Town Manager, Town and Village of Bennington, Vt.; previously Town Manager, Stoughton, Mass.

APPLYING FOR JUNIOR

BROOKS, KENNETH WILLIAM, Independence, Kans. (Age 25) 1940 B.S. in A.E., Univ. of Ill.; June 1941 to July 1942 Jun. Engr., U.S. Engr. Dept., at present Asst. Engr.

CUSACK, JAMES HAYDEN, Marienville, Pa. (Age 32) (Claims RCA 3.0) 1942 B.S.C.E., Pa. State Coll.; April 1942 to date 1st Lieut., Corps of Engrs., U.S. Army; previously with Pennsylvania Dept. of Highways, Dist. 11.

DOUGLASS, MARTIN KEITH, New Westminster, B.C., Canada. (Age 24) 1942 B. of Applied Sci., Univ. of British Columbia; May 1942 to date Instrumentman, Dept. of Transport, Bureau of Civil Aviation.

HARRIS, ERNEST CHARLES, Cleveland, Ohio. (Age 27) (Claims RCA 0.1) March to May 1938, Jan. to April 1941 (evenings), and March 1942 to date with Fenn Coll., on various work, since March 1942 Instructor in Structural Eng.; in the interim with U.S. Engr. Office, Cincinnati, Ohio, with the American Mono Rail Co., etc.

KING, DAVID HERMAN, Spencer, Iowa. (Age 27) June 1942 to date Asst. Engr., Bldg. Sec., U.S. Engrs.; previously Instructor, Gen. Eng. Dept., Iowa State Coll.

KNIGHT, ALEXANDER, Tucson, Ariz. (Age 33) May 1942 to date Chf., Survey Party, Arizona Constrs., Marana, Ariz.; previously (while student) Campus Engr., Univ. of Arizona.

PAGE, GORDON BENJAMIN, Albuquerque, N.Mex. (Age 31) (Claims RCA 2.0) July 1940 to date on active duty with Corps. of Engrs., U.S. Army, at present Capt. (Reserve), acting as Operations Officer; previously with SCS, U.S. Dept. of Agriculture, Navajo Dist.

PAXSON, JAMES TYLER, Monroe, La. (Age 27) Jan. 1942 to date Chf. of Party with Black & Veatch; previously Engr. with A. Farnell Blair, Contr., Atlanta, Ga.; Ordnance Inspector, St. Louis Ordnance Dist.; Instrumentman with Atlantic Refining Co., Longview, Tex.

TUCKER, JOHN THOMAS, Knoxville, Tenn. (Age 33) 1942 B.S. in Civ.Eng., Univ. of Miss.; June 1942 to date Jun. Structural Engr., TVA; previously with U.S. Engrs. in various capacities.

1941 GRADUATES

UNIV. OF KY. (B.S. in Civ. Eng.)

	Age
BAUGHMAN, JOHN HENRY	(24)

STANFORD UNIV. (A.B.)

CRANDALL, DAVID LYNN	(23)

1942 GRADUATES

UNIV. OF AKRON (B.C.E.)

MARK, WILLIAM	(22)

ALA. POL. INST. (B.C.E.)

CLARK, WILLIAM WINFIELD	(22)
HENRY, WILLIAM LEDBETTER	(25)
HEWITT, CLYDE BURTON, JR.	(20)
JONES, JAMES AUSTIN	(21)
MIDDLETON, CHARLES CALLOWAY, JR.	(22)

UNIV. OF ARK. (B.S.C.E.)

SEELY, LLOYD JACK	(24)

UNIV. OF CALIF. (B.S. in Civ. Eng.)

ALEXANDER, JOHN ALEXANDER	(25)
LIPINSKI, LESTER STANLEY	(23)

CARNEGIE INST. TECH. (M.S. in Civ. Eng.)

FRILER, ALFRED MARTIN (Also 1941 B.S. in Civ. Eng.)	(22)

(B.S. in Civ. Eng.)

TOMASSETTI, BENJAMIN GABRIEL	(21)

CORNELL UNIVERSITY (B.C.E.)

MILHAN, DAVID WARREN	(21)

DREXEL INST. TECH. (B.S. in Civ. Eng.)

ACKERMAN, EDWARD	(23)
BERMAN, MORTON JACK	(23)
CROWE, JOHN WERNERT, JR.	(25)
ECKARDT, GEORGE HERBERT, JR.	(23)
HARTMAN, GEORGE JOSEPH	(23)
KEALEY, THOMAS ROBERT	(21)
LANGFORD, ROBERT PAUL	(23)
MISSIMER, HERTEL CURTIS, JR.	(23)
POPP, ROBERT FRANK	(23)
SPINDEL, ERVIN	(24)
WESTON, RICHARD GEORGE	(23)

UNIV. OF FLA. (B.C.E.)

COCKRELL, JOSEPH OSBORNE	(21)

GEORGE WASHINGTON UNIV. (B.C.E.)

DOUGLAS, WALTER ROBINSON	(20)

GA. SCHOOL TECH. (B.S. in C.E.)

CASSELL, JAMES ROBERT	(26)

HARVARD UNIV. (S.M.)

LARKIN, DONALD GOODHUE (Also 1941 B.C.E., Manhattan Coll.)	(23)